SCHOOL OF PUBLIC HEALTH

COLLEGE OF HEALTH SCIENCES

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IMPACT OF COVID -19 ON THE HEALTH AND WORK OUTPUT OF HEALTHCARE WORKERS IN SELECTED HOSPITALS WITHIN THE GREATER ACCRA REGION OF GHANA

BY

BENSON OWUSU

10598525

THIS THESIS IS SUBMITTED TO THE SCHOOL OF PUBLIC HEALTH, COLLEGE OF HEALTH SCIENCES, UNIVERSITY OF GHANA LEGON IN PARTIAL FULFILMENT FOR THE AWARD OF DOCTOR OF PHILOSOPHY (PhD) PUBLIC HEALTH DEGREE.

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DECLARATION

DECLARATION BY CANDIDATE

I, OWUSU BENSON hereby declare that except the references made to other peoples' work which I have duly acknowledged, this research which is my original work has neither in whole nor in part been presented to the University or elsewhere for another degree.

Signature Date 30/05/2025

Owusu, Benson

DECLARATION BY SUPERVISORS

We hereby declare that the principal work and presentation of this thesis were supervised by us in accordance with guidelines on supervision of thesis laid down by the University of Ghana

Principal Supervisor

Signature ....

Date 30th May, 2025

Dr. Reginald Quansah

Co-Supervisor

Signature ....

Date: 30th May, 2025

Prof. Mawuli Dzodzomenyo

Co- Supervisor Signature

Date: 30th May 2025

Signature

(Dr. Prudence Tettey)

DEDICATION

I dedicate this work to my late father, Mr Emmanuel Owusu Atuahene, who longed to see me graduate but died during my PhD journey, and to my wife, Dr Magdaline Ansah, for her unwavering and unrelenting help throughout my studies.

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LIST OF ABBREVIATIONS

APOR	Adjusted Proportional Odds Ratios
BEOH	Biological, Environmental and Occupational Health Sciences
BMI	Body Mass Index
BP	Blood Pressure
COVID-19	Coronavirus 2019
DASS-21	Depression, Anxiety and Stress Scale - 21
DALY	Disability Adjusted Life Years
DBP	Diastolic Blood Pressure
DLCO	Diffusing Lung Capacity for Carbon Monoxide
FVC	Forced Vital Capacity
FEV1	Forced Expiratory Volume at the First Second of Exhalation
GHS	Ghana Health Service
HCWs	Healthcare Workers
ICU	Intensive Care Units
MERS	Middle East respiratory syndrome
MERS-CoV	Middle East Respiratory Syndrome Coronavirus
PFT	Pulmonary Function Test
PL	Productivity Loss
RNA	Ribonucleic Acid
SAR-CoV	Severe Respiratory Syndrome Coronavirus
TLC	Total Leukocyte Count
TMPRSS2	Transmembrane Serine Protease 2
TSS	Total Severity Score
SBP	Systolic Blood Pressure
SPH	School of Public Health
SWB	Subjective Well-Being
UK	United Kingdom
VIF	Variance Inflation Factor
VOLP	Valuation of Lost Productivity Approach

ABSTRACT

The COVID-19 pandemic put a lot of pressure on the health system which was not prepared enough to handle it. Many Healthcare workers (HCWs) got infected, with some developing health complications after recovery. This study assessed the risk factors of post-COVID-19 complications among HCWs. A follow-up study using census was used to recruit 756 HCWs of which 252 (Exposed group) were infected with COVID-19 and 504 (unexposed group) were not. Stata LP Version 15 was used for the analysis. The Pearson chi-square test was used to assess the association between health outcomes and the exposure status at baseline, month 3, and month 6. The interaction between COVID-19 exposure status during these months that showed significant association with the health outcomes (psychological health, blood pressure, lung function and presenteeism) were included in the multilevel generalized ordered logistic regression model, estimating the adjusted proportional odds ratios (APOR) and the corresponding confidence interval and p-values. All analyses were considered statistically significant at an alpha level of 0.05. The majority of the HCWs reported having a history of comorbidity with the commonest being hypertension. These reports were significantly higher among HCWs in the exposed group. The multilevel analysis demonstrated a significant association between depression, anxiety and stress and sociodemographic factors, history of comorbidities, lifestyle choices, family and workplace support ($p<0.001$). There was a significant association between health outcomes (reduced normal, blood lung function) and sociodemographic factors, family and personal history of comorbidity, lifestyle choices, family and workplace support ($p<0.001$). Furthermore, increased odds of experiencing low levels of presenteeism were reported among HCWs with severe levels of anxiety, whiles reduced lung function and psychological health problems were reported among the exposed group. This proves the significance of stakeholders to prioritize the health and safety of HCWs in the face of disease outbreaks, since it can affect the quality of work.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

In June 2012, a patient in a Jeddah, Saudi Arabian hospital, passed away from a severe respiratory condition caused by the Middle East respiratory syndrome (MERS), a novel deadly infectious disease that occurs in humans (MERS-CoV) (Zaki et al., 2012; Giri et al., 2021). The features of MERS-CoV are similar to those of SARS-CoV, the virus that causes respiratory illnesses, which had consequently produced the SARS pandemic in Asia in February 2003. The two beta coronavirus outbreaks throughout the past 20 years have had a major effect on humans, with mortality rates of 10% for SARS-CoV and 35% for MERS-CoV (Giri et al., 2021; Azhar et al., 2019).

Recently, reports of a new respiratory sickness caused by the SARS-CoV-2 virus have surfaced. This illness is commonly referred to as coronavirus-2019 [COVID-19] (Bogoch et al., 2020; Lu et al., 2020). A single strand of ribonucleic acid (RNA) makes up the nuclear material of certain coronaviruses, which have a size range of 65 to 125 nm (Ysrafil, 2020). Considering the illness is a highly contagious droplet infection, more people are at risk of getting it. The fast spread of COVID-19, which is thought to have originated in Wuhan, China and may have been triggered by contact with a seafood market, has affected more than 200 nations (Huang et al. 2020). The World Health Organization (WHO) (2020) declared the coronavirus epidemic a pandemic on March 30, 2020 and a public health emergency of international concern on January 30, 2020.

Globally, 13.6 billion doses of vaccines have been given as of May 30, 2025. There have also been 7,010,681 deaths and 704,753,890 confirmed cases of COVID-19 worldwide (WHO, 2024). Ghana, however, has recorded 1,462 COVID-19-related mortalities as of May 30th,

2025. However, deaths related to healthcare workers [HCWs] are inconclusive (Piredda et al., 2022). While the WHO (WHO, 2025) reports 115,000 HCWs deaths, Amnesty International estimates more than 17000 HCWs deaths (Tipping, et al., 2022).

According to the WHO (2012), HCWs are all people engaged in actions whose primary intent is to enhance health, including nurses, midwives, physicians, laboratory technicians, and hospital administrative staff. Undeniably, COVID-19 has had tremendous impact on all facets of life, especially on healthcare workers [HCWs] and particularly frontline HCWs (WHO, 2021; Hossain et al., 2021), as more frontline HCWs were exposed to the virus in the course of administering care and treatment to COVID-19 positive patients (Chersich et al., 2020; Rees et al., 2021; Lozada-martínez et al., 2021). Stated differently, globally, the COVID-19 pandemic is linked to an increase in HCW mortality and morbidity cases. This could be worse and more challenging in the second year of the pandemic than the first (WHO, 2022), particularly as more contagious mutant viruses proliferate in the northern hemisphere (Lapid, 2021). The danger of infection has grown considerably due to the virus mutation. Healthcare workers were predicted to have an infection rate of 14.5% overall, with a case fatality rate of roughly 9 deaths per 1000 infections (Chutiyami et al., 2022).

Therefore, occupational contact with HCWs is one of the most important concerns that must be handled thoroughly. Yet, the rate of infection of the virus among HCWs in Ghana has not been reported, thus undermining the effect of the pandemic on the healthcare system. To protect and ensure continuous patient care and to make sure HCWs do not spread the virus, it is critical to secure their safety. To ensure this, a lasting solution must be found. Therefore, data is important in understanding the causes and routes of exposure among HCWs in Ghana.

It is a no-brainer that COVID-19 is highly contagious; hence, people, especially HCWs, are generally susceptible because HCWs lead the management of COVID-19. Unfortunately, because of their increased contact with contagious patients, the virus' relative novelty, and the healthcare system's lack of readiness to handle the rapid inflow of cases, HCWs are an infection target (Al Abri et al., 2021). According to the WHO assessment, HCWs comprised 20% of the population infected by the SARS outbreak in 2002 (Hsin-Chen & Macer, 2004). The effects on the healthcare system are particularly worrying, considering that hospitals are already overrun with patients and that infection among HCWs would worsen the already acute staffing constraint for containing disease outbreaks (Al Abri et al., 2021).

It is evident that the infection rate of HCWs is rising globally as more than 20% of all HCWs caring for COVID-19 patients in Italy, one of the top 5 countries distressed by COVID-19, contracted the virus themselves (The Lancet, 2020). By March 2020, there were 9400 HCWs infected with COVID-19 in Spain, accounting for roughly 15% of all cases (Ali et al., 2020). There were reports of 18% of HCWs in Ohio and the USA having the infection (Ali et al., 2020). According to the Ministry of Health of Oman, out of the 57340 HCWs working in public and private institutions in 2019, 847 HCWs had COVID-19, with a 1.47% incidence (Ministry of Health (MOH), 2019). In the United Kingdom [UK], it is reported that the fatal risk of infection of the new coronavirus variant among HCWs is 35% higher than that of the original strain (Jin et al., 2021).

Two significant COVID-19 risks of infection among HCWs were identified as exposure to infected patients and work overload (Ran et al., 2020; Mhango et al., 2020). This is consistent with a previous analysis from the Centers for Disease Control and Prevention, which indicated that out of the 9,282 instances of COVID-19 among HCWs in the United States, 55% had exposure in the hospital sector (Centers for Disease Control and Prevention, 2020). A mathematical modelling study by Temime et al. discovered that HCWs had a greater risk for COVID-19 than the general public because they interact more frequently with infected people (Temime, 2020). Another study reported that 22 HCWs died as a result of severe respiratory distress among the estimated 3,300 infected HCWs (The Lancet, 2020). According to a Wuhan study, close contact with COVID-19 patients, extended work hours, and inadequate hand cleanliness were all possible risk factors for HCWs to become infected with the virus (Ran et al., 2020). Quantitative research has demonstrated that frontline healthcare personnel who treat COVID-19 patients are more likely to have mental health issues due to their workload, including stress, anxiety, depression, and sleeplessness (Liu et al., 2020; Vindegaard & Benros, 2020).

From the preceding, programs for the prevention and control of COVID-19 need to be customized based on each country's infection rate. Understanding the risk factors for COVID-19 infection among HCWs in Ghana is important to characterize the transmission patterns of the COVID-19 virus and avoid the infection of future HCWs and others they come into contact with.

The first stage of COVID-19 pathogenesis is the virus' infiltration through the receptors on the intended host cell. The SARS-CoV-2 is composed of four main structural glycoproteins: the spike (S), membrane (M), envelope (E), and nucleocapsid (N) (Bohn et al., 2020), while the M, E, and N proteins are necessary for the assembly and release of viral particles, the S protein is in charge of the virus' binding and entry into host cells (De Wit et al., 2016; Li, 2012). Many studies have determined that the entrance receptor for SARS-CoV-2, a virus that resembles SARS-CoV, a human angiotensin-converting enzyme 2 (ACE2). (Letko et al., 2020; Ou et al., 2020). The primary mode of transmission for SARSCoV-2 is by large respiratory droplets. The virus directly infects cells in the upper and lower respiratory tract, especially alveolar epithelial cells and nose-ciliated cells (Zhou et al., 2020). In cases of viremia, ACE2 expression has been found in other human tissues, including the small intestine, kidneys, heart, thyroid, testis, and adipose tissue. This means that the virus can also directly infect cells in other organ systems. (Mengyuan-Yuan et al., 2020). It is unexpected to learn that SARS-CoV-2 has a higher affinity for the ACE2 receptor than SARS-CoV, despite sharing a 72% amino acid sequence (Chan et al., 2020; Chen et al., 2020).

The virus enters the cell through the combination of the host cell's and viral membranes after strictly sticking to the host cell (Masters, 2006). For membrane fusion to occur, a number of coronaviruses, including SARS-CoV, need S-protein priming or cleavage by transmembrane serine proteases or host cell proteases (Belouzard et al., 2009; Bertram et al., 2011). Transmembrane serine protease 2 (TMPRSS2), which cathepsin B/L can substitute, is required for S-protein priming to facilitate SARS-CoV-2 entry into host cells, as demonstrated by Hoffmann et al. (2020). It is unclear if SARS-CoV-2 host entry requires cleavage by a furin-like protease. Furin-like proteases are widely expressed, despite their low levels, which implies that S-protein priming at this cleavage site may contribute to the cell tropism and enhanced transmissibility of SARS-wider CoV-2 (Shapiro et al., 1997). The evolution of the distinctive S1/S2 cleavage site in the S protein of SARS-CoV-2 is unique. This site is characterized by a four-amino acid insertion and is absent in other coronaviruses (Anand et al., 2020).

It has been determined that some viruses have evolved this chemical mimicry as an effective adaptation for preying on the host cell's machinery (Bohn et al., 2020). Hence, the pathophysiology of the virus must be determined among HCWs, who are considered knowledgeable about the preventive measures against the virus and how to curtail the spread.

With an incubation period between 2 to 14 days, the main clinical manifestations of COVID-19 are fever, difficulty breathing, dry cough, rhinorrhea, fatigue, and loss of taste and smell, among others. COVID-19 is spreading worldwide (Tian et al., 2020). Many clinical studies have also suggested that patients with COVID-19 have multiple organ damage, including the circulatory system, urinary system, nervous system, and digestive system, among others.

Ageusia and anosmia, however, have become frequent symptoms and strongly suggestive of COVID-19 due to the rising number of reports on the clinical aspects of the illness (Montano-Castellon et al., 2022). The two symptoms that infected HCWs most frequently, as reported in a study, were anosmia and ageusia, and the incidence of COVID-19 substantially correlated with their existence (Vaira et al., 2020). Typically, these symptoms do not involve nasal obstruction or rhinitis symptoms; this is most likely the result of direct virus damage to the gustatory and olfactory receptors (Bachi et al., 2020) or a changed mucosal immune response in the upper airways (Montano-Castellon et al., 2022). Even among HCWs who are vaccinated, some exhibited symptoms such as fever, sore throat, and coryza (Filho et al., 2022). This might be the result of multiple SARS-CoV-2 variants, which are known to exhibit certain clinical features compared to others.

Numerous measures have been taken to 'halt' and minimize the transmission of SARS-CoV-2 because of the continuing threat that COVID-19 poses to healthcare systems and society. Many nations have used measures such as quarantine, hand washing with soap and water, use of alcohol-based sanitiser, social exclusion, and complete lockdowns to stop the virus' spread (Chutiyami et al., 2022). In Ghana, additional actions including the partial lockdown of some sections of the nation (March 2020), the closure of borders (air, land, and seaports), and the suspension of public gatherings (i.e., religious activities, funerals, weddings, sporting events, restaurants, night clubs, and beaches) were implemented as a measure to control the spread of the virus. Additionally, public locations (including public transit hubs and farmers and community markets) were fumigated, and mass testing was performed by contact tracing of selected populations (in April 2020) (Bannor et al., 2021).

Though there is no definite drug for treating COVID-19, the COVID-19 case management team is currently using many treatment regimens, such as remdesivir, azithromycin, lopinavir-ritonavir, and hydroxychloroquine (among other drugs) (Zhou et al., 2020; Cao et al., 2020). Real-time reverse transcription PCR (RT-PCR) remains the laboratory investigation of choice in diagnosing COVID-19 (Tang et al., 2020).

As efforts from frontline healthcare providers sought to control the spread of the COVID-19 virus by treating affected persons, some of these healthcare providers contracted the virus. While some of these health workers recovered from the virus, studies examining the post-recovery health impact of the virus are lacking in Ghana. The present study sought to fill this gap in the literature by prospectively assessing the risk factors associated with COVID-19 complications among healthcare workers post-recovery in the Greater Accra Region with particular focus on the Greater Accra Regional Hospital, Achimota Hospital, Tema General Hospital and Shai Osudoku District hospital.

1.2 Statement of the Problem

Currently, over 7 million HCWs have been infected with COVID-19 globally, and more than 100,000 have died despite measures adopted to reduce the rate of infection (WHO, 2025). There were reported variations in the deaths of HCWs across the globe, where there were more than 60,000 reported deaths in the Americas, close to 50,000, in Europe, about 1500 in South

East Asia, more than 2000 deaths in the Eastern Mediterranean and 1427 deaths in Africa within a year of the infection (Bandyopadhyay et al., 2020). These deaths notwithstanding, HCWs endured arduous work schedules in high-stress settings and had ethical predicaments concerning difficulties in providing superior treatment, potentially as a result of inadequate staffing. (Greenberg et al., 2020).

In addition to raising the likelihood of cardiovascular comorbidities among HCWs, these extraordinary circumstances had the potential to raise the risk of mental health conditions such as post-traumatic stress disorder (PTSD), depression, anxiety disorders, substance abuse, and suicide. A report by the GHS in June 2020 showed 779 HCWs had been infected with the disease, with 10 associated deaths. The case count increased to over 2000 by the end of July 2020, with many of them unable to go to work and isolated while waiting for their COVID-19 test results after being exposed to COVID-19 patients.

This demonstrates how essential it is to recognize those presenting with signs of psychological symptoms and to initiate a more intensive treatment plan to ensure increased productivity, as development of post-COVID complications including depression anxiety, stress, hypertension, reduced lung function and presenteeism have the potential of crippling the health system when HCWs develops them. Research on the impact of COVID-19 on the health and work output among HCWs in Ghana remains scanty. It is against this background that the study was undertaken.

1.3 Justification

Currently, health workers affected by COVID-19 represent 10% of the global cases despite measures adopted to reduce the rate of spread of infection (WHO, 2020). This situation has mounted unprecedented pressure on global health systems, including Ghana (Ozili & Arun, 2021). Using daily or weekly data, the growing body of literature on COVID-19 has investigated the effects of the viral dilemma. Generally speaking, they concentrate on a particular industry, such the tourism sector (Gössling et al., 2020), the mining sector (Laing, 2020), the healthcare sector (Ather et al., 2020), or the economy (Fernandes, 2020; Ozili & Arun, 2020; Fornaro & Wolf, 2020). The impact of the COVID-19 pandemic on HCWs post recovery is yet to be examined in Ghana.

Hence, this study will help identify the after-effects of COVID-19 among healthcare workers who have survived the disease, thus helping inform the Ghana Health Service, as well as the Ministry of Health, on the length of time health workers must be put under surveillance even after recovery from the virus. Additionally, findings from this study will serve as a baseline for assessing complications associated with health workers after COVID-19 recovery and help develop a pathway to monitor and provide comprehensive medical assessments and multidisciplinary rehabilitation even after surviving the disease (Salawu et al., 2020).

This study is timely, as it will inform the Ministry of Health about the importance of boosting hospital staff strength to compensate for healthcare workers who might develop post-recovery complications from the disease . A shortage in staff strength will increase the pressure on the health system, thus reducing patient care quality. Furthermore, this study will inform the Ministry of Health about providing health workers with the needed personal protective equipment (PPEs) to reduce the risk of infection, as well as development clinical practice guidelines on the management of COVID-19 among HCWs.

1.4 Conceptual framework

The conceptual framework in Figure 1.1 shows direct relationship between COVID-19 exposure status and health outcomes, as well as presenteeism. It also conceptualizes from literature the mediating effect of history of comorbidities, lifestyle/physical activity, as well as family/workplace support in the relation between COVID-19 exposure and health outcomes, and presenteeism.

Various factors can influence the outcome of COVID-19 patients after they recover from the disease, which invariably affects their work output. Demographic factors, including age, sex and religion, play a major role in the risk of contracting the disease as well as recovering from the disease. Age plays a significant role in recovering from any disease, as the probability of having a comorbidity increases with age. These comorbidities if present can, to a large extent, lower immunity, thereby making recovery a challenge. This is not different from ageing among HCWs who contract COVID-19. Thus, being older and contracting COVID-19 influences work output, including HCWs (Hu et al. 2021). The sex of an individual has an influence on their work output after contracting COVID-19. Naturally, women are assumed to be risk-averse compared to men. Thus, women are more likely to be affected psychologically after contracting COVID-19, which will invariably influence their work output. Yet, men are more likely to be affected by COVID-19, considering their affinity for risk-ridden situations.

Males are more likely than females to contract COVID-19 whereas the severity rate is higher in older people than in the youth (Bherwani et al., 2020; John & Shaiba, 2019; Liu et al., 2020). Being overly religious can influence the work output of individuals who contract COVID-19, and HCWs are no different (Kowalczyk et al., 2020). The study showed that people believe that the object of worship will protect them from contracting the disease. This could also translate to those who test positive for COVID-19 to rather believe they can be healed through prayers than seek the appropriate care. This can make them develop COVID-19-associated complications even after recovering from the disease, thereby affecting their work output.

The individual's marital status is central to their recovery after contracting the Coronavirus (Brewin et al. 2010; Tempest et al. 2017). Being married or in a romantic relationship can provide psychological support for prompt recovery while also providing them with the psychological fortitude to give their best at work after recovering from the virus. This is truer for healthcare workers because their recovery is important in the 'fight' against the deaths and recovery of COVID-19-affected patients who throng the various health facilities to seek medical help. Another important factor that can affect the work output of HCWs during and after their recovery from contracting COVID-19 is the level of income. If one earns enough, they can afford the needed supplements and medications as well as access psychological support post-COVID-19 recovery. This is central to contributing completely to the recovery process for patients seeking care to recover from COVID-19. Then again, in understanding the cause, mode of transmission, treatment available and ways of preventing COVID-19, the level of education (knowledge) of the individual is very important. Among health workers, having adequate knowledge is key to preventing and identifying COVID-19-associated complications in seeking medical care.

Studies have shown that COVID-19-related complications are high among people with comorbidities such as diabetes, tuberculosis, cancers, and sickle cell (Brurberg & Fretheim, 2020; Wang et al., 2020). These pre-existing diseases are strongly associated with the risk of developing severe symptoms of COVID-19, while the severity of the disease is a significant factor influencing recovery from the disease. Healthcare workers who present with such comorbidities are likely to suffer from a reoccurring episode of COVID-19, thereby affecting their work output as a result of fear of aggravating their condition. Furthermore, hypertension, reduced lung function, diabetes, cardiovascular condition, and respiratory disorders, among others, are health impacts of COVID-19 that can influence the recovery of healthcare workers who contract the virus (Danzi et al. 2020; Yang et al. 2020). Such risk factors hamper the recovery process from the virus, which invariably affects healthcare workers psychologically and their work output when returning to the hospital to continue their work duties.

Furthermore, occupational factors such as the number of patients HCWs attend to, especially during peak periods of the virus, and the availability or otherwise of personal protective equipment (PPEs), among others, can have excruciating stress on their well-being (Wang et al. 2020; Talaee et al. 2020). Increased stress levels among HCWs during the COVID-19 pandemic may be a sign of dedication to their work and selflessness. On the other hand, this high stress levels may have negative health impact on healthcare workers. Health institutions need to have comprehensive care plans that safeguards the health needs of HCWs and their immediate family members like their spouse and children in case of any eventuality, as well as tighten the hospitals infection protection protocols. This will lessen HWCs anxiety on fear of the unknown whiles attending to the medical needs of patients at the hospital. When these things are in place, it will lessen their financial responsibilities to their families when they contract COVID-19 from the HCWs as well as reduce the risk of contracting any health condition due to stress levels, which in turn can positively affect their work output.

Employees in the medical field who treat COVID-19-positive patients run the risk of contracting the virus. Naturally, their concerns are about contracting the illness and spreading it to patients, family members, and co-workers. The level of risk of contracting COVID-19 infection among HCWs, coupled with the incidence of severity of the disease, can influence the work output of healthcare workers. The severity of the COVID-19 is one of the most significant factors influencing recovery from the disease. Since the outbreak in Ghana, even among healthcare workers, most people get tested for COVID-19 weeks after exposure to the virus. It also takes several weeks to get results even after the test, which delays the health-seeking behaviour if they are positive for the disease. Early recognition, identification, isolation, and appropriate infection prevention and control measures are imperative for early treatment to increase healthcare workers' work output.

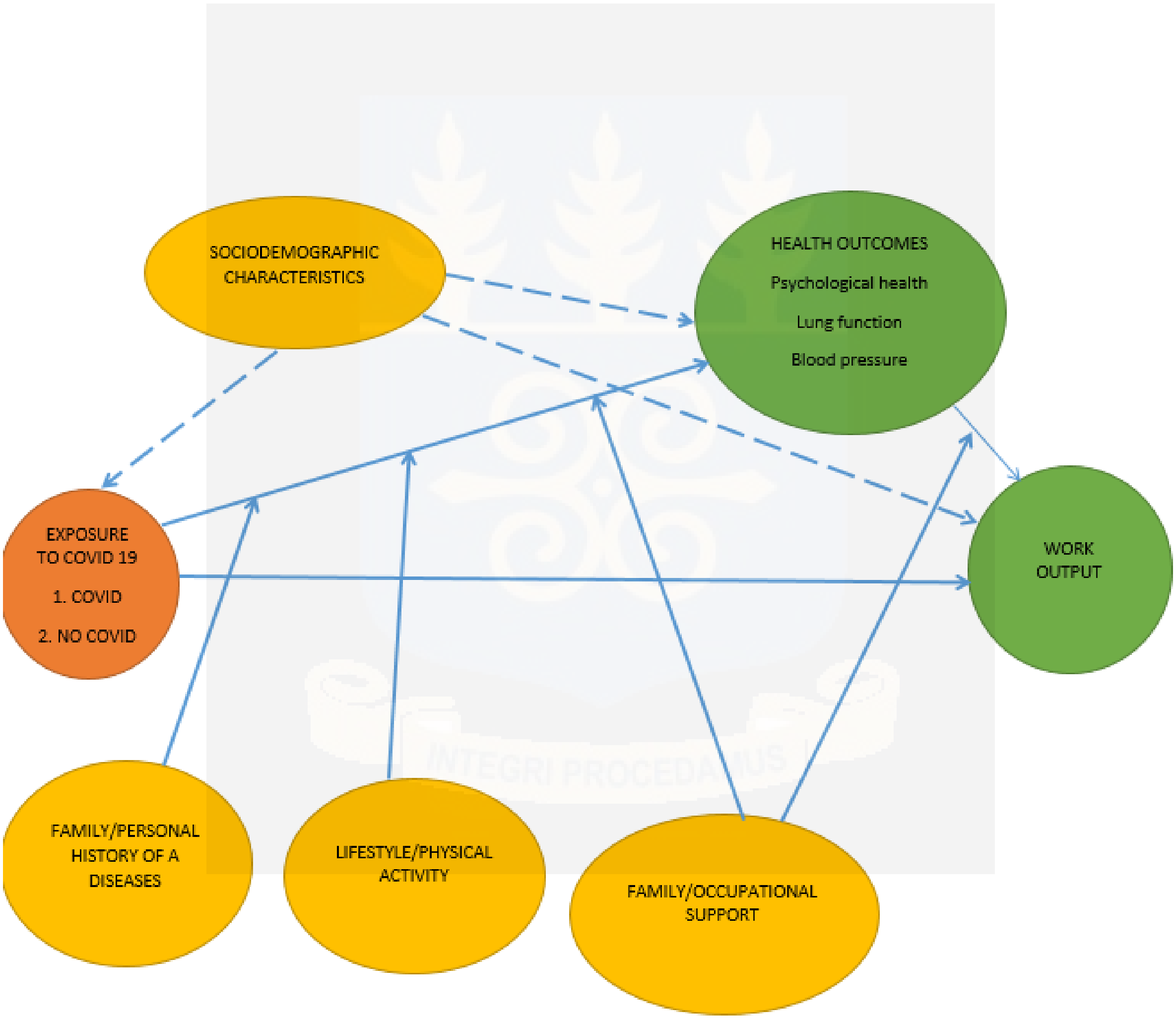

Figure 1.1: Conceptual Framework Showing the Impact of COVID-19 on the Health and Work Output of Healthcare Workers
(Source: Researcher's construct, 2022)

1.5 Objectives

1.5.1 General Objective

This study aims to determine the risk factors associated with post-COVID-19 complications among healthcare workers in selected hospitals in the Greater Accra region of Ghana.

1.5.2 Specific Objectives

The study sought to:

1. To examine the clinical characteristics and management of COVID-19 among healthcare workers diagnosed with the disease

2. a. To determine the effect of COVID-19 on health outcomes (that is, psychological health, lung function), and blood pressure.

b. To investigate the mediating effect of lifestyle/physical activities, family/work-related support, and history of comorbidity between COVID-19 and health outcomes as well as presenteeism.

3. To determine the effect of COVID-19 on work output (presenteeism)

1.6 Research Questions

The following research questions are posed based on the specific objectives.

1. What are the clinical characteristics of COVID-19 and how was it managed among healthcare workers who were diagnosed with the disease?
2. a. What are the effects of COVID-19 on health outcomes i.e. psychological health, blood pressure and lung function among healthcare workers.
   b. How does lifestyle and physical activities, family/work-related support, and history of comorbidity mediate the relation between COVID-19 and health outcomes, as well as presenteeism?
3. What are the effects of COVID-19 on work output (presenteeism)?

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents the risk factors associated with COVID-19 complications among HCWs post-recovery. Also, the review presented information on the after-effects of COVID-19 on health outcomes among HCWs with particular focus on psychological health, blood pressure level, lung function, lifestyle choices, professional characteristics, family/work-related factors and family/personal history with COVID-19 and the relation with health outcomes. Further review is presented on the effect of COVID-19 on work output among HCWs post-recovery using presenteeism as a proxy. Therefore, an extensive literature search was conducted regarding the post-recovery complications of COVID-19 among HCWs using the School of Public Health, University of Ghana Library database, searches with Medline, CINAHL, PubMed and Google Scholar (English only, full text). The keywords that served as a guide for the search were; "Risk factors of COVID-19", "psychological symptoms AND sociodemographic factors", disease severity AND reduced workout", "psychological symptoms AND work-related stress", "disease severity AND health impact of COVID-19".

The search was not restricted by publication date or nation; studies had to be published in peer-reviewed journals in order to be taken into consideration for the literature review. The search was defined by studies that pertained to the study's objectives. The selected studies were reviewed under the major themes, separated, and screened for relevance and applicability.

2.2 Clinical characteristics and management of COVID-19 among HCWs diagnosed with the disease

A comprehensive review of the clinical characteristics and management of COVID-19 was explored by Guan and He (2023). The authors found that certain individuals reported experiencing systemic symptoms like weariness, malaise, hyposmia, dysgeusia, and respiratory symptoms like cough, dyspnea, and fever. Out of those admitted, almost 50% of them were still stable. COVID-19 can induce a complex inflammatory disorder in infants and adolescents, which can be fatal and primarily presents as gastrointestinal, cardiovascular, hematologic, and mucocutaneous problems. In certain PCR-positive symptomatic individuals, radiologic anomalies may not be detected upon assessment. When they are initially admitted, over half of the patients show patchy shadowing and ground-glass opacity. This condition can swiftly progress to diffuse ground-glass opacity, consolidation, or mixed patterns. Laboratory abnormalities include thrombocytopenia as well as elevated levels of C-reactive protein, alanine aminotransferase, aspartate aminotransferase, creatinine, kinase, d-dimer, and neutropenia. Lymphopenia is substantially connected with the prognosis.

Patrícia et al.'s (2021) systematic review (n=16; 53.3%) on pre-existing conditions among health professionals impacted by COVID-19 revealed that more than half of the population had comorbidities such as diabetes mellitus (DM), obesity, systemic artery hypertension (SAH), and chronic obstructive pulmonary disease (COPD) prior to testing positive to COVID-19. In 18 (60%) of the research that examined the clinical features of COVID-19 presentation, it was found that fever, cough, weariness, myalgia, diarrhoea, and sore throat were the most common symptoms among healthcare professionals. According to the studies, healthcare workers required intensive care in 3 cases (10%) and had some disease severity in 4 cases (13.3%). The findings confirm the wide range of professional categories infected by COVID-19. It also shows that nurses and physicians have higher exposure rates of 27.3% and 13.2%, respectively. This conclusion is most likely related to the fact that they have direct interactions with infected patients and uninterrupted interactions (particularly in nursing).

A study, which aimed to examine the clinical, and sociodemographic traits linked to hospitalization and mortality of healthcare personnel in Brazil due to COVID-19 revealed that women made up 75.6% of the confirmed cases. Overall hospitalization rates were 0.99% and 0.27%, respectively. Hospitalization and the clinical outcome were linked to fever, dyspnea, male gender, age ≥50, higher education, cough, cardiac comorbidity, diabetes, and obesity. Renal comorbidity, runny nose, sore throat, headache, and hospitalization were the only symptoms linked to cases recorded in the Victoria metropolitan area. The occupation of nurses had the greatest incidence rate. A low overall case fatality rate, a high incidence in nurses, and a high frequency of cases among women were all shown by the study (Corona & Cunha, 2022). Using an integrative evaluation of research, the study sought to determine the traits of health professionals impacted by COVID-19 (Patrícia et al., 2021). The statistics showed that 10,760 health workers were included in the selected research; most were members of the nursing team (27.3%) and physicians (13.2%). Most research (n=20; 66.6%) confirmed that health professionals were exposed to contaminants during work, primarily in hospitals. The primary means of diagnosis was "Reverse Transcriptase – Polymerase Chain Reaction (RT-PCR)" testing. The majority of studies listed workers' prior comorbidities. The primary signs of COVID-19 among impacted healthcare workers included fever, coughing, exhaustion, and myalgia. There were traits discovered that correspond to a focused profile of physicians and nurses who were contaminated at the hospital. Cross-sectional studies conducted in China, Italy, and North America were the main emphasis of this reality.

In Wuhan, the writers registered 140 healthcare professionals with COVID-19. Data on epidemiology, demographics, clinical, laboratory, radiation therapy, and clinical outcomes were acquired, along with predictors of the duration of viral shedding (Liu, Liu, et al., 2020). The findings revealed that COVID-19-positive medical staff displayed few clinical complaints and few aberrant test indications. The medical staff, comprising 96 (68.6%) females, 39 (27.9%) with underlying conditions, a median age of 36.0 years, and 104 (74.3%) who contracted the infection while working in the hospital, were all cured and released. The virus shed for a median of 25.0 days (IQR: 20.0–30.0). According to multivariable linear regression analysis, the Recombinant human interferon alpha (rIFN-a) treatment was linked to a shorter duration of viral shedding. However, the duration of viral shedding was linked to the use of glucocorticoids, the time interval between hospital admission and the onset of symptoms, and improvement in chest computed tomography (CT) data. Furthermore, persistent viral shedding was seen in infected healthcare workers whose lymphocyte count was less than 1.1 9 109/L upon admission. In conclusion, medical staff exhibit milder clinical aspects when making timely interventions. Prolonged viral shedding is linked to lymphocyte counts less than 1.1 9 109/L and glucose-cortisol therapy. The duration of viral shedding can be shortened by early admission and rIFN-a treatment.

The frequency, clinical characteristics, and prognosis of healthcare workers (HCWs) with positive COVID-19 were investigated in a northwest Malaysian facility (Ainur et al., 2023). A total of 198 HCWs in all were involved. The majority (72.2%) were female; their mean age was 39.9 + 6.55 years; 96% were Malay; 46% were nurses; 92.4%) had no co-morbidities; and 97% had received both doses of the COVID-19 immunization. 65 HCWs may have acquired the virus at work, but 115 HCWs may have gotten it from the community. The majority of the employees (84.3%) had symptoms. The typical signs and symptoms were fever (49%), runny nose/nasal congestion (22.2%), sore throat (40.4%), cough (33.8%), and cough. Also, 82.8% of HCWs had a stage 2 COVID-19 diagnosis overall. After receiving two immunization doses, the typical duration of illness was almost five months. 76.2% of them were manageable at home at the time of diagnosis, and no deaths were reported. HCWs with symptoms had a notably longer time between receiving the COVID-19 immunization and being infected. When comparing stage two COVID-19 to stage one COVID-19, the HCWs with the latter diagnosis had a noticeably longer vaccination-to-infection interval. Healthcare workers' protection during the endemic phase and the creation of efficient preventative measures for optimal pandemic management depends on the periodic evaluation of COVID-19 infection among HCWs.

Amer et al. (2021) assessed the epidemiological and clinical manifestation of COVID-19-affected healthcare workers (HCWs) in Saudi Arabia. Ninety-seven per cent of the twelve thousand HCWs employed by King Saud Medical City (KSMC) throughout the study period tested positive for COVID-19. Eighty-five per cent of HCW infections were obtained in the community, including through transmission in hospital dorms. The majority of hospital-acquired incidents were transmitted among personnel. The 12-hour shifts were more common in the medium and high-risk areas, where 99.8% of study participants reported receiving direct patient care, compared to 3.4% in the low-risk areas (p-value <0.001). Additionally, 93.1% of healthcare workers in the high-risk areas reported experiencing at least one symptom, compared to 81.6% in the low-risk areas. Elarslan et al. (2021) examined the clinical traits of coronavirus-infected healthcare workers (HCWs) and explored the variables that influence the severity of the illness in Turkey. The study included 79 HCWs, whose mean age was 33.37 ± 8.44 years. There were 32 male and 47 female participants in all. Thirty-nine individuals were in the pneumonia group, and fifty patients were in the uncomplicated group. Fourteen healthcare workers had been admitted to the hospital, with an average stay of 5.43 ± 1.5 days.

Compared to the uncomplicated group, the pneumonia group had more hospitalizations (n = 11) than the other group. There was a higher likelihood of pneumonia among healthcare workers (HCWs) assigned to high-risk units compared to other hospital areas.

Regarding workers' age, gender, occupation, and presence of chronic illness, there was no significant difference between the groups. At 34.2% and 31.6%, respectively, sore throat and cough were the most prevalent disease-beginning symptoms. Biochemical measurements showed no variation between the groups. The authors concluded that healthcare professionals were susceptible to contracting COVID-19. High-risk unit workers were particularly susceptible. Tan-Loh and Cheong (2021) sought to improve knowledge of the main COVID-19 clinical symptoms among healthcare workers (HCWs) at Hospital Teluk Intan, Malaysia. It was established that 47 HCWs had COVID-19 positive tests. The patient's average age was 37.5 years old. There were seven individuals (15.2%) with at least two comorbidities. The mean interval between perceived close contact and symptom onset was 4.5 days, and the mean interval between symptoms and the first positive RT-PCR result was 3.4 days. Of the patients, 40 (87.0%) experienced at least one symptom before hospitalization, while six (13.0%) remained asymptomatic the entire time. The three most often reported symptoms were cough (37.0%), sore throat (391%) and fever (65.2%). Most of the patients (Group 2, 52.2%) had minor symptoms in terms of severity. It was necessary to admit two patients (4.3%) who had multiple comorbidities to the intensive care unit and to use mechanical breathing. There were no fatalities, and the patient who stayed in the hospital with the longest stay was there for eighteen days. While no HCWs who were directly involved in the care of COVID-19-positive patients tested positive, the high rates of transmission among HCWs can be linked to spending time nearby during the asymptomatic incubation phase.

Filho et al. (2022) assessed the clinical traits and results of healthcare workers (HCWs) who had COVID-19 before and after vaccination in Brazil. The findings revealed that 22267 healthcare workers were suspected of having COVID-19. There were 14 388 (64.6%) negative tests and 7879 (35.4%) positive tests. Positive predictors of COVID-19 included fever, cough, exhaustion, and dyspnea. Negative predictors included headache, sore throat, coryza, working in a region where COVID-19 was prevalent, and receiving COVID-19 immunization. 58.8% of the visits were from unvaccinated HCWs, while 41.2% were from vaccinated HCWs. 84 (1.1%) of the HCWs with COVID-19 required hospitalization; 11 (0.1%) of them were in an intensive care unit (ICU), and three (0.04%) of them died. Six hospital stays, all of which were brief and did not require ICU admission or result in fatalities, happened among vaccinated healthcare workers.

2.3 Effect of COVID-19 on the Psychological Health of HCWs

Psychological discomfort is a condition of emotional anguish that is accompanied by physiological symptoms such as sleeplessness as well as symptoms of depression, anxiety, and restlessness (Drapeau et al., 2012; Mirowsky & Ross, 2002; Payton, 2009). Psychological distress is associated with behavioral and psychophysiological symptoms that manifest over time (Marchand, 2004). A consistently depressed state and lack of interest, together with unpleasant feelings and difficulty fulfilling everyday responsibilities, are characteristics of depression, a mental mood condition (Bonde, 2008; Cummins et al., 2015). Untreated psychological distress can result in serious depression and suicide (Marchand, 2004; Cummins et al., 2015). Psychological distress and depression are the results of severe or persistent stress that has not been managed, mostly attributed to an individual's incapacity to manage stressful life circumstances (Cummins et al., 2015; Drapeau et al., 2012; Marchand, 2004). An enormous amount of stress is being caused by the present epidemic for everyone on Earth.

Depression, anxiety, and burnout are just a few examples of the negative mental states and clinical effects that can result from psychological discomfort. These might harm a person's daily life and social interactions (Horwitz, 2007). Burnout is a phrase used in psychology to describe a bad reaction to ongoing professional stress. According to reports, it happens when individuals devote excessive time, energy, and effort to their jobs over a lengthy period without having adequate time to rest physically or mentally (Thorsen, Tharp & Meguid, 2011). Many employees in the healthcare industry are at significant risk of burning out. Most of the day is spent providing patients with the care they need.

Burnout affects healthcare workers universally and negatively impacts all aspects of health. Due to their need to oversee the workload of numerous patients, healthcare workers working in the front lines of the COVID-19 epidemic have been under a lot of stress. It was shown that burnout was more prevalent in regions where the virus was spreading at the time the data was collected. In two hospitals in Wuhan, China, cross-sectional research was done with a focus on frontline nurses who were taking care of COVID-19 patients in 2014. (Hu et al., 2020). The survey's findings revealed that frontline nurses experienced significant emotional weariness (41.5%) and high levels of depersonalization (27.6%) when caring for COVID-19 patients. The results of this study show a significant incidence of burnout among HCWs due to the rise in COVID-19 patients, and many of the frontline nurses in Wuhan reported moderate burnout. This increase in patient demand can dramatically impact the risk that a nurse may experience burnout. This study sheds insight on the prevalence of burnout and its impact on the nurses who were first assigned to care for COVID-19 patients.

A survey measuring exposure, perception, and workload received responses from participants in 60 countries. As a result of their burnout while working during the pandemic, 51.4% of participants in the study in 33 countries stated that they experienced emotional fatigue (Azoulay et al., 2020) as a result of receiving insufficient PPE (45.2%), having access to mental health care (52.2%), and not receiving COVID-19-specific training (53.1%). Because HCWs were not given access to these alternatives, these factors influenced workplace productivity and safety. It increased their worry and anxiety while also putting many workers in danger of catching the illness.

A meta-analysis was conducted to quantify the most often reported psychological symptoms. One of the most prevalent mental health issues among this demographic was fear (43.7%). Additionally, this fear was linked to a frequency of psychological suffering (37.8%) (de Pablo et al., 2020). This may have resulted from the pandemic's many contributing elements, including the rise in demand for longer work and hours. The survey also noted a greater incidence of depressed (26.3%) and anxious (29%) traits in HCWs (de Pablo et al., 2020). This was contrasted with the earlier population, which was infected with the SARS/MERS virus. The COVID-19 pandemic showed around a 10% increase in anxiety and depression symptoms compared to earlier epidemics. In addition, HCWs reported feeling stigmatized more frequently than the general population (39.5%) (de Pablo, et al, 2020). Because these HCWs interact with COVID-19 patients, several reported that their friends and family have shied away from them for fear of getting the virus. This could make HCWs feel cut off from their network of support, which hurts their mental health.

Notwithstanding their everyday struggles, a thorough investigation found that these healthcare workers maintained a strong sense of duty and dedication to patient care. This study found that despite the dangers of the scenario, nurses felt a great commitment to carry out their professional obligations during the outbreak (Fernandez et al., 2020). Professionalism was something that many of these nurses enjoyed much. Eventually, they showed great commitment to patient care since they felt they still had responsibilities in spite of the risk of infection. This commitment presents moral and ethical dilemmas for many who have to choose between exposing themselves to patients or their families. Healthcare professionals' psychological well-being is still being impacted by this sacrifice.

2.4 Effect of COVID-19 on Blood Pressure among HCWs

Researchers are becoming more aware of hypertension because it is more common in COVID-19 patients (Schiffrin et al., 2020). According to observational and retrospective studies conducted near Wuhan, the most common comorbidity (hypertension) was seen in COVID-19 patients, with rates ranging from 15 to 30% (Wang et al., 2020a; Zhang as al., 2020c; Zhou et al., 2020). One of the biggest trials took place in Wuhan between December 11, 2019, and January 29, 2020, with 1,099 COVID-19 patients. Fifteen percent, or 165 individuals, had hypertension. According to the same study, the overall severity of the disease was higher in 23.7% of hypertensive patients and 13.4% of normotensive patients (Guan et al., 2020). In a separate Chinese study, 138 patients with laboratory-confirmed COVID-19 had a similarly high prevalence (31.2%) of hypertension. Furthermore, the researchers found that, in contrast to 21.6% of those with normal blood pressure, 58.3% of COVID-19-infected hypertensive patients were admitted to intensive care units (ICUs) (Wang et al., 2020a). In a group of 1,590 patients from 575 institutions, pre-existing hypertension was independently associated with severe COVID-19 (hazard ratio 1.575, 95% CI: 1.07-2.32) (Guan et al., 2020). In a nutshell, the findings indicate that people who have high blood pressure are at a higher risk of experiencing severe COVID-19 outcomes.

According to a recent study, only when combined with diabetes or another risk factor, was hypertension a reliable predictor of outcome (Sun et al., 2020). Additionally, it should be noted that some studies (Gupta et al., 2020) did not find any correlation between either hypertension or diabetes and poor outcomes in COVID-19 patients. In contrast, other studies reported that both conditions, whether or not they were associated with obesity, were independently linked to poor outcomes (Giannouchos et al., 2020). According to Bauer et al. (2020), hypertension was only a significant independent predictor of a severe form of COVID-19 among individuals under the age of 65 and not across the board in the research group. Conversely, among patients under 65 and all individuals, diabetes and congestive heart failure were independent predictors. With 15,794 patients, Barrera et al. found that diabetes and hypertension alone were significant predictors of ICU admission and death but not severe COVID-19 (Barrera et al. 2020). Interestingly, severe COVID-19 was not predicted by concurrent hypertension and diabetes.

Grasselli et al. (2020) found that comorbidities like high blood pressure, diabetes, cardiovascular disease, hypercholesterolemia, chronic renal disease, and others were predictive of death in a study involving about 4,000 critically ill COVID-19 patients who were admitted to the intensive care unit. Among these comorbidities, diabetes and hypercholesterolemia were the only independent predictors. Age and chronic renal illness were the only independent prognostic factors, although diabetes was not, according to research that only examined people with hypertension. The same study found no indication of an interaction between age and hypertension, diabetes, or obesity as independent predictors of severe COVID-19 in either sex, and that obesity was a stronger predictor in individuals under 50 (Denova-Gutiérrez et al., 2020). Further research, looking at 19,256 COVID-19-related ICU hospitalizations, revealed that patients with type 2 diabetes had a higher death risk despite having other potential risk factors such as hypertension, chronic renal disease, chronic liver disease, chronic lung illness, and chronic cardiac disease (Dennis et al., 2020). Acute respiratory distress syndrome (ARDS) or death was not associated with hypertension, according to a recent study of COVID-19 participants (Sun et al., 2020). According to the authors, the only combination of hypertension and diabetes was a reliable predictor of death and ARDS in COVID-19 patients. Additionally, in these patients, diabetes by itself was independently linked to worse outcomes.

According to research conducted by Ran et al. (2020) on 803 COVID-19-positive hypertensive patients, average systolic blood pressure is the only factor that may independently predict the development of heart failure in these individuals. Higher chances of death and ICU admission were also strongly correlated with increased BP fluctuation. The authors demonstrated that patients with high systolic blood pressure had considerably higher odds of developing COVID-19-induced heart failure. At the same time, this tendency was less pronounced in individuals with high diastolic blood pressure (Ran et al., 2020). This study demonstrates that high blood pressure (BP) is a significant predictor of unfavorable outcomes and that systolic blood pressure should be the main focus of BP control in COVID-19 patients.

According to Chen et al. (2020), mortality outcomes, respiratory failure, mechanical ventilation, and ICU hospitalization gradually increased from normotensive patients with COVID-19 to those with grade I, II and III hypertension. Even while there was a tendency for all outcomes, one must accept that there was no discernible difference between participants with grade I hypertension and normotensive individuals, as well as between those with grade II and III hypertension. It is interesting to note that the severity of the sickness and its symptoms grew with time. Grade II hypertension was independently related to adverse outcomes in a multivariable analysis. Despite its considerable prevalence among COVID-19 patients in the overall trial group and notably among hypertensive participants, diabetes was excluded from the multivariable analysis (Chan et al., 2020). Due to its significant variability and dependence on comorbidities, determining the link between BP and COVID-19 results is complex. Additionally, because both trials included hospitalized patients, BP was evaluated after admission rather than when symptoms first appeared. As a result, COVID-19 may have already influenced BP.

2.5 Effect of COVID-19 on Lung Function among HCWs

Numerous investigations have revealed that individuals who recovered from SARS showed persisting abnormalities during prospective follow-up that lasted for months or even years (Schelling et al., 2000; Orme et al., 2003). A longitudinal 1-year follow-up of SARS survivors revealed that the first half-year after recovery was marked by persistent abnormalities observed in lung function tests and impairment in diffusing capacity for carbon monoxide (DLCO) (Hui et al., 2005). Moreover, 110 patients underwent CPET according to Clavario et al. (2020). Three months after discharge, they found that a little more than a quarter (34%) of non-severe patients, that is, those who were not in need of an intensive care unit had reduced aerobic capacity, primarily due to muscle damage. Similar findings were shown one month following discharge: majority of the patients (70%) had decreased peripheral muscle mass (Blokland et al. 2021), and patients had lower aerobic capacity, which was probably due to physical deconditioning rather than changes in pulmonary function (Gao et al., 2021). In 58 patients, Raman et al. (2021) found that the aerobic capacity of COVID-19 patients was lower 2-3 months after the beginning of symptoms than that of controls (54% vs 7.4%). While most of these studies reported worse lung function results among respondents, it must be noted that most respondents were 50 years and above. Advancing age can be a condiment for lung function failure as other comorbidities accentuate the situation.

This challenge, nonetheless, is that the present study replicates the findings from these studies. However, the present study sought to use a fairly young population.

Moreover, a retrospective research of COVID-19 patients at a university hospital located in China looked at the effect of the virus on pulmonary function in the early phases of recovery. (Huang et al., 2020). According to the research, 75.4% of the patients had abnormal pulmonary function testing results; 10.5%, 8.7%, 43.8%, 12.3%, and 52.6% of patients had FVC, FEV_1, FEV_1/FVC ratio, TLC, and diffusing lung capacity for carbon monoxide (DLCO) values that were, respectively, less than 80% of anticipated values. The incidence of DLCO impairment was greater in severe patients than in non-severe cases, the lung total severity score (TSS) and R20 were higher, and the proportion of predicted TLC and 6MWD was considerably lower. Though this study was retrospectively done, it has implications for the present study. Thus, COVID-19 attacks the organs, particularly the lungs, making breathing difficult for patients, irrespective of profession. Yes, the study may have missed some confounders, but COVID-19-positive patients who are severely affected are likely to show the symptoms reported in the study. Hence, the present study used a prospective approach to ascertain the effect of COVID-19 on the lung function of healthcare workers in Ghana.

Similar findings were reported by Frija-Masson et al. (2020) in 45 patients with mild (n = 12), moderate (n = 17), and severe (n = 16) sickness. They also observed that, in line with expectations, there was a higher rate of Pulmonary Function Test [PFT] anomaly in patients with severe disease. As a result, 81% of the patients in this group had abnormal PFTs, most of which showed reduced DLCO and total leukocyte count (TLC). Lerum et al. (2020) stratified patients according to the necessity for admission to an intensive care unit; this may have been explained by the inclusion criteria, which did not show a significant difference between the groups. Even though nearly a quarter (24%) of all patients had DLCO values below the lower limit of normal, there was no discernible difference between the groups. Van den Borst et al. (2020) gathered PFT measures from 124 COVID-19-infected people about three months following hospital discharge in one of the largest European studies. Comparing the disease severity of this cohort, no differences were observed in spirometry or static lung volumes. While over one-third of patients with moderate disease (33%) and over half of patients with critical (55%) or severe (54%) disease had significantly impaired DLCO, all patients with mild disease had DLCO within normal levels. For the avoidance of doubt, HCWs who contract COVID-19 become patients who HCWs treat.

Oliveira et al. (2022) review of studies found that those who have recovered from COVID-19 may exhibit symptoms of cardiopulmonary sequelae, including exercise intolerance, chronic thrombosis, right ventricular dysfunction, and persistent lung fibrosis. One of the most dreaded COVID-19 chronic lung consequences is pulmonary fibrosis. Clinical, radiological, and pathological evidence should all be considered when making a post-COVID interstitial lung disease (PCILD) diagnosis. There is conflicting evidence about the effectiveness of anti-fibrotic and anti-inflammatory medication therapy in reducing PCILD symptoms. A significant fraction of COVID-19 patients have issues related to their coagulation. The COVID-19 pandemic may eventually see a rise in the prevalence of chronic thromboembolic disease (CTED), pulmonary hypertension in the setting of CTED (CTEPH), and other types of pulmonary hypertension due to acute pulmonary embolism. Right ventricular dysfunction is common in SARS-CoV-2 hospitalized patients, and it is more likely associated with systemic effects than with acute viral myocardial infection. Exercise limitation during COVID-19 infection can be caused by a central or peripheral cardio circulatory origin, reduced oxygen absorption, and ventilatory or gas exchange constraint, among other causes. It is essential to refer a patient who has COVID-19 infection and is still experiencing symptoms to a pulmonary rehabilitation program to expedite their recovery and enable them to resume their productive life. Therefore, findings from these studies have implications for the present study. Firstly, how does the severity of the HCWs recruited for the study affect the lung function results, hence, their DLCO levels? Does the number of COVID-19 patients HCWs attend post-recovery affect their lung function? The present study sought to determine if geographic settings or differences affect the lung function of HCWs in Ghana.

2.6 Effect of Lifestyle and Physical Activity on COVID-19 Health Outcomes

In cohorts of COVID-19 patients possessing body mass index (BMI) data, it was demonstrated that those who were obese had a higher risk of experiencing severe COVID-19 outcomes (Sattar, McInnes, & McMurray, 2020). There was a sizable knowledge gap, too, because there was far less information available about the contribution of some of the upstream behavioral drivers of the obesity pandemic, such as the quantity of physical activity during leisure time. According to Ross et al. (2016), regular exercise reduces the risk of developing chronic illnesses such as type 2 diabetes, cardiovascular disease, and respiratory disorders. Obesity and chronic illness rates are rising in large part due to poor diets (high-calorie intake, low consumption of fruits and vegetables, consumption of salty foods, etc.) (Kant 2010). Research indicates that some dietary practices may affect inflammatory indicators linked to systemic inflammation at a low level (Casas et al. 2014; Del Chierico et al. 2014).

Furthermore, hypoxemia and endoplasmic reticulum stress are linked to hypertrophic adipose tissue, which is associated with excess body fat. These events trigger the activation of inflammatory genes and a prolonged inflammatory response. Both directly (Laddu et al. 2021) and indirectly (Pietiläinen et al. 2010) through the vicious cycle of inactivity and obesity, physical inactivity is associated with a compromised immune response. Consequently, immunological and host defense systems are adversely affected by inadequate diet, obesity, and inactivity. After controlling for sociodemographic factors, self-rated physical health, perceived social support, and loneliness, a cross-sectional study on perceived lifestyle changes following the COVID-19 outbreak and their association with subjective well-being (SWB) among the general population in Mainland China found that inactive physical exercise (odds ratio [OR] 1.16, 95% CI 1.02-1.48), infrequent vegetable intake (OR 1.45, 95% CI 1.10-1.90), infrequent fruit intake (OR 1.31, 95% CI 1.01-1.70), and often skipping breakfast (OR 1.43, 95% CI 1.08-1.91) were associated with lower SWB (Hu et al., 2020). Another study used cross-sectional studies to evaluate risk factors, including unhealthy nutrition, obesity, and physical inactivity, in patients infected with SARS-CoV-2. Their effects on the severity and duration of the disease were evaluated and reported that patients with lower levels of physical activity or lower MET.min/week were affected by a more severe form of the disease ($p = 0.05$ and $p = 0.03$, respectively) (Tavakol et al. 2021). These findings indicate that increasing physical activity levels may partly reduce the severity of COVID-19.

Altering our eating patterns and way of life might harm our health. Proper nutrition is essential, especially when the immune system must defend itself. One of the populations at greatest risk for COVID-19 problems is people with significant obesity (BMI 40 kg/m^2) (CDC, 2020). Adipose tissue expands with obesity, producing cytokines and fostering an inflammatory environment (Hauner, 2005). Additionally, patients with obesity have worse functional capacity, expiratory reserve volume, and respiratory system compliance when it comes to pulmonary physiology. Reduced diaphragmatic excursion in individuals with excessive belly obesity further impairs pulmonary function in the supine posture, making breathing more challenging (Dietz & Santos-Burgoa, 2020). While these studies' findings are true and have implications for the present study, the pace at which exercises are undertaken could prove important. For example, healthcare workers could be perceived to be busy during the peak of COVID-19, which could affect the rate at which they exercise. However, there are huge differences in the number of COVID-19 cases during the peak of the virus. The differences in the pandemic's peak, notwithstanding, make physical activity the priority of the individual, irrespective of profession. Thus, some HCWs could be active but contract the virus and vice versa, probably due to their inability to sleep well. Again, the way of life of some HCWs could be altered due to the pandemic, and most could struggle to overcome such challenges. Studies assessing such a situation in Ghana are sparse. Hence, this study sought to contribute to the literature on the effect of physical activity/exercise on health outcomes among HCWs post-COVID-19.

2.7 Effect of Family/Work-Related Support in the Relation between COVID-19 and Health Outcomes

Regulations governing social distance were imposed almost everywhere during the COVID-19 pandemic as a containment strategy. A lockdown is a strict national/local quarantine measure that restricts movement by requiring people to stay at home except when performing essential tasks or working in a necessary capacity. It differs from self-isolation, which encompasses both isolation and quarantine and social isolation, which is confined to one's home and keeps oneself apart from others.

People who were infected but asymptomatic were forced to live in isolation, either by themselves or with other family members who shared their condition. They were terrified of developing severe symptoms and frequently felt abandoned by the healthcare systems. Nursing home residents who have been denied even the closest family member visits and contact for months have developed a sense of dismay and neglect, which has worsened their pre-existing depression or dementia status (Reinhold et al., 2021). In addition, hospitalized patients were segregated into their rooms, interacting only with the medical staff, who were donned in masks and other personal protective equipment. There were limited opportunities to learn the health status of other family members throughout the inpatient stay, and no family communication was permitted during that time (Reinhold et al., 2021).

Recent research suggests that those who live at home are at a significant risk of developing anxiety and depression symptoms (Brooks et al., 2020). Many people may have fallen into the anxiogenic loop of constant news reporting about contagions and pandemic-related casualties, which exacerbated anxiety and bewilderment due to a lack of antihuman contact and separation from reality. According to earlier research (Petit et al., 2018; Howard et al., 2018), people with hypertension are more prone to experience psychological discomfort or anxiety, and they also have more difficulties expressing their emotions in stressful settings. These unfavourable emotions, exacerbated by lockdown, self-isolation, familial and personal issues, as well as psychological pain relating to one's own or a relative's health, may have led to a worsening of health outcomes.

Research conducted by Bai et al. (2004) found that given that they worked at the hospital, healthcare workers were more likely to face rejection and stigma in their community. According to Kinsman (2012) and Zhang et al. (2020a), stigmatization may cause a great deal of psychological distress and grief. They may have intense symptoms, like in incidents where neighbours threw stones at medical personnel and drove them from their homes during the Ebola pandemic (Guimard et al., 1999). Providing early and correct information about the condition, by some writers, may lessen the stigmatization of healthcare professionals (Bai et al., 2004).

2.8 Effect of COVID-19 on Work Output (presenteeism) among HCWs Post-Recovery

The COVID-19 virus is responsible for a sizeable number of illnesses and even mortality among healthcare workers (HCWs) (Behzadnia & Saboori, 2020). The severity of the issue is made worse by healthcare systems losing medical personnel and scarcity issues in some nations (Zhang et al. 2012). Employee productivity will suffer as a result of sick days and missed work. Productivity loss (PL) resulting from health issues is called health-related PL. The presenteeism (working while ill), absenteeism, and the incapacity to conduct unpaid work due to illness are the three elements that seem to be accountable for health-related productivity loss, according to the Valuation of Lost Productivity Approach (VOLP) (Zhang et al. 2012).

According to a systematic review, presenteeism productivity losses per healthcare staff ranged from 2000 USD to 15,541 USD yearly. Additionally, absenteeism costs more than presenteeism. These projections were made using a broad computation and had nothing to do with a particular illness (Lui, Andres, & Johnston, 2018). Although presenteeism is more common among HCWs, absenteeism has a higher financial cost (Rantanen & Tuominen, 2011). The anticipated costs of permanent and transient productivity loss, according to Nurchis et al. (2020) are 300 and 100 million euros, respectively. The DALY of COVID-19 assessed for the entire population in South Korea accounted for 10.3% of YLLs and 89.7% of YLDs. These investigations demonstrated that, although having fewer fatalities than disabilities, YLLs have a larger monetary value than YLDs and a bigger impact on lost productivity.

Health care workers' COVID-19 infection is one of the reasons behind absenteeism. There are different data on infection rates. Productivity loss is affected by the length of the quarantine, the duration of the treatment, and the number of days an individual takes off from work (Yaghoubi, Salimi, & Meskarpour-Amiri, 2022). A person can typically return to work in 10 to 14 days (Wang, Lee, & Zhou, 2020). Gianino et al. (2019) computed the number of HCWs (5041) who missed work owing to seasonal influenza. According to the findings, there were over 11,100 lost working days annually, costs of roughly 1.7 million euros, and an average loss of employment of roughly €327 per individual (Gianino et al., 2019). The extent of productivity loss brought on by viral infections is seen in the study conducted by Gianino et al. (2019).

A study carried out in Saudi Arabia among physicians, nurses, dentists, pharmacists, and other professionals working at a tertiary facility revealed that 74% of the employees had absenteeism due to illness at some point in the year (Al-Nuhait et al. 2017). Presenteeism productivity loss was estimated to cost between 19.92 and 315.57 TRY for two weeks and 478.08 and 7573 (Sikkema et al. 2020). TRY for a year in research among HCWs in Turkey. The leading cause of YLDs (Whiteford et al. 2013) and the greatest percentage of daily productivity loss among HCWs is mental disorders, followed by chronic low back pain (Allen et al. 2018). Research conducted on stress among Chinese healthcare workers (HCWs) found a strong correlation between stress and presenteeism, that is, presenteeism rose in proportion to stress levels (Yang et al. 2019; Yang et al. 2018). Burnout among HCWs is made more likely by these issues (Allemann, Siebenhüner, & Hämmig, 2019). An investigation among Croatian nurses revealed a substantial link between stress and presenteeism but not an association with absenteeism (Brborovic, Brborovic, & Mustajbegovic, 2016). These studies highlight the significance of psychiatric diseases and their implications on lost productivity.

2.9 Effect of health outcomes (hypertension, psychological problems and lung function) on work output (presenteeism)

This study aims to evaluate the direct impact of job stress, health state, and presenteeism on task performance in order to provide a theoretical foundation for improving the performance of medical personnel (Jia et al., 2022). The results showed that, in that order, the mean scores for work stress, health state, presenteeism, and job performance were 2.05 ± 0.84, 4.18 ± 0.68, 2.15 ± 0.79, and 4.49 ± 0.64. The findings of the ANOVA showed that there were significant differences in task performance scores among different demographic groups, such as gender, age, marital status, department, professional title, and work experience. There was a negative correlation found between task performance and presenteeism as well as stress at work. The relationship between task performance and health status was good. Presenteeism and health status acted as a mediating factor in the relationship between task performance and work-related stress. The association between task performance and health status was mediated by presenteeism. In conclusion, medical staff task performance was significantly impacted negatively by work stress and presenteeism, whereas task performance was significantly positively impacted by health status. In the meantime, presenteeism and health status served as moderators in the association between task performance and work stress, and presenteeism and health status served as moderators in the relationship between task performance and health status.

García-Iglesias et al. (2023) conducted a comprehensive review in order to identify the factors influencing workers' presenteeism and mental health during the COVID-19 pandemic (2023). This review included 25 trials with a total of 164,274 participants. Their work indicated that a number of factors affect both mental health and sick leave. These include factors related to mental health, such as stress, depression, burnout, fear of COVID-19, lack of well-being, individual factors, such as age, health status, and having a chronic illness; factors related to the COVID-19 situation, such as confinement, symptoms, risk of bankruptcy, and so on; and 4 factors derived from working conditions, such as organizational support, patient care, working functioning or task performance impairment, fatigue, safety climate and workload amongst others.

In Yaghoubi et al.'s (2022) study, Iranian physicians, nurses, and paramedics who directly cared for COVID-19 patients were asked to rate the degree, financial impact, and influencing variables of presenteeism and absenteeism due to the virus. The results revealed that the frequencies of COVID-19 infection were 18.6% in paramedics, 18.7% in nursing staff, 8% in physicians, and 14.4% in healthcare personnel. There is a considerable association between working in intense units and absence. A first-time COVID-19 infection was linked to a greater level of absenteeism across all people. Present smoker employees were 2.995 times more likely to be absent from work than employees who had stopped smoking. In conclusion, COVID-19 notably impacted healthcare professionals' presence and absenteeism, with varying amounts and values among doctors, nurses, and paramedics.

This study sought to determine workplace factors linked to poor mental health among New York's healthcare workers during the COVID-19 outbreak (Cheslack-Postava et al., 2022). They found that individuals who worked closely with patients while ill had increased odds of poor mental health (adjusted odds ratio, 2.29; 95% confidence interval, 1.71–3.08). These risk factors were also independently linked to working longer hours than usual in the previous two weeks, experiencing COVID-19 symptoms, having family members or friends who passed away from the virus, and dealing with inadequate personal protective equipment or other shortages. They concluded that a number of the COVID-19 pandemic-related occupational factors were linked to poor mental health outcomes for healthcare professionals, some of which may be changed.

This study set out to conduct a global survey to evaluate the effect of COVID-19 on chronic disorders (Chudasama et al., 2020). Respondents comprised 202 healthcare professionals (HCPs) from 47 countries: Europe was represented by 47%, Asia 20%, South America 12%, Africa 10%, North America 9%, and Oceania 2%. There were 46 (23%) nurses, 41 (20%) other HCPs, 40 (20%) hospital physicians, and 75 (37%) primary care doctors. Just 14% of respondents said they were still providing all consultations in person, while the majority said that all consultations were now done over the phone (45%) or only a portion (35%). The 6% of HCPs that chose "other" emphasized the usage of telemedicine, namely the use of Zoom, Skype, WhatsApp, and Facebook Messenger for online video consultations. A few mentioned making house calls or calling off their outpatient appointments. Reductions in healthcare resources connected to COVID-19 have been found to have the greatest impact on diabetes (38%) among other conditions. The subsequent conditions most affected were depression (6%) and cancer (6%) followed by heart disease (7%), hypertension (8%), asthma (7%), and chronic obstructive pulmonary disease (COPD, 9%). Moreover, COVID-19 had an effect on care for the two most common co-occurring chronic conditions: diabetes and hypertension (30%), diabetes and COPD (13%), and heart failure and COPD (8%). The majority of healthcare professionals (HCPs) (67%) believed that their patients experienced moderate to severe impacts from changes in healthcare services following the outbreak; nonetheless, the overall management of patients' chronic illness care was viewed as fair (48%) or good (26%).

Blake et. al set out to investigate the association between the use of well-being centres, the well-being of healthcare workers, and variables connected to their jobs in the UK, such as presenteeism, job satisfaction, workplace stress, and turnover intentions (Blake et al., 2024). HCWs did not use the wellness centres, and their absence from work resulted in worse job satisfaction, higher job stressfulness, higher presenteeism, and younger age. Using the centre was linked to well-being regardless of work stress. Those who visited the centre but did not report presenteeism had poorer well-being (M = 3.06, SE = 0.04) than those who did report presenteeism and used the centre (M = 3.30, SE = 0.04). While job stress and satisfaction revealed substantial impacts, centre utilization had an insignificant nexus with turnover intentions. In conclusion, HCWs who had access to wellness centres reported being in better health overall, especially concerning presenteeism.

A study evaluated presenteeism in respiratory therapists and nurses who work directly with patients in the United States of America, both minority and non-minority (White-Means et al., 2022). They found that Memphis' respiratory therapists and nurses were affected by COVID-19. According to their findings, 77% of respondents continued working despite their health issues, suggesting they demonstrated presenteeism for the period. About 40% of participants said working during the COVID-19 pandemic influenced their physical and mental health, whereas 38% said working impacted their emotional health. During the COVID-19 pandemic, nurses and respiratory therapists reported being less productive. Approximately 67% of the participants reported declining overall productivity at work. Roughly 25% of respondents believed their productivity had decreased by 10% to 30%, while 32% believed their output had decreased by 40% or more. These workers were unable to do any of their job duties while at work, but they were also unable to take time off from work because they were considered vital. About half of the participants stated that they did not think their employer offered them enough support to practice their job safely, and about forty-five per cent said there were no options for them to change their work schedules or take time off, such as paid time off for vacation, personal leave, or illness. Thirty-three per cent (33%) said they didn't have proper access to personal protective equipment. However, 77% of respondents felt comfortable asking management or fellow employees for help when unsure what to do during this extraordinary period. For this group, as with other Americans, the pandemic had a major impact on family life; about 84% of participants reported this to have happened to their families.

A mixed-method study examined the psychosocial challenges and possible benefits that long-term care facility nurses encountered during the German COVID-19 outbreak(Schulze et al., 2022). The respondents discussed the mental and physical effects of adhering to the hygienic standards implemented in the assisted living facility. Long lines at the locker room or the inability to take joint breaks were caused by staff shortages, which also resulted in extended working hours. Interviewees specifically mentioned feeling under more strain because they had to wear personal protective equipment (PPE), which included masks, visors, hazmat suits, gloves, hats, and overshoes. Changing into and out of personal protective equipment (PPE) multiple times daily posed a considerable challenge to daily care routines beyond the physical consequences. This was especially true during active outbreaks. The prohibition of family members visiting residents, implemented in most homes during the first wave of the pandemic (March 2020) and the third wave (December 2020–March 2021), caused respondents to report feeling more stressed. When visitors spend time with particular residents, they often help and relieve care of personnel; however, this support abruptly stops. Even worse, interviewers frequently felt that their families added to their stress. It was necessary to keep family members updated on residents' conditions, and respondents offered them emotional support when a resident's condition worsened. Notifying family members of a deceased person's sudden passing caused significant distress for several individuals. Furthermore, several relatives refused to comply with the rules and accused the interviewers of preventing them from seeing.

Eryl et al. (2021) explored how the COVID-19 epidemic has affected Metro Manila's front-line medical staff's mental health. With the exception of stress and anxiety related to age before the epidemic and stress related to duration of service before the pandemic, there were no discernible changes in the demographic profiles. According to the Depression Anxiety Stress Scale (DASS-21) and the impact of event scale with modification for COVID-19 (IES-COVID-19), frontline medical staff members' mental health is greatly impacted by the COVID-19 pandemic. When comparing pre-pandemic results to post-pandemic results, there was a rise in the number of respondents with 'normal' values. Regression research shows that depression is where COVID-19 has the biggest effect, followed by anxiety and stress. An investigation looked at the connection between regular medical care being interrupted during the coronavirus disease pandemic of 2019 and employee absenteeism in Japan (Okawara et al., 2022). The results revealed that, of the 27 036 people, 17 526 (65%) were workers who did not need regular medical care, 8451 (31%) used medical care in accordance with their plan, and 1059 (4%) had their medical care stopped. Compared to workers who did not require routine medical care, workers who had interrupted medical treatment had an adjusted odds ratio (AOR) of sickness presenteeism that was significantly higher (3.44; 95% confidence interval [CI]: 3.04–3.89). Workers with mental health symptoms had the highest adjusted odds ratio (AOR) in terms of symptoms.

In light of socioeconomic and lifestyle characteristics, the relationship between depression and sick presenteeism among Korean workers during the COVID-19 epidemic was ascertained. (Lee et al., 2020). The results indicated that 1700 individuals, or 2.2% of the total, reported having depression symptoms in 2020. Also, of the 27 036 people, 17 526 (65%) were workers who did not need regular medical care, 8451 (31%) used medical care in accordance with their plan, and 1059 (4%) had their medical care stopped. Compared to workers who did not require routine medical care, workers who had interrupted medical treatment had an adjusted odds ratio (AOR) of sickness presenteeism that was significantly higher (3.44; 95% confidence interval [CI]: 3.04–3.89). A study conducted at the University of York in the United Kingdom examined how job-related stress levels and functioning were affected by the COVID-19 outbreak and policies like furlough and remote work (Van Der Feltz-Cornelis et al., 2020).Nine hundred and twenty-five students and one thousand and fifty-five employees answered the survey. Seventy-eight per cent of students and ninety-eight per cent of staff studied or worked from home. It was found that 10% of students and 7% of employees missed work due to illness. Presenteeism affected 40% of pupils and 26% of staff. Also, 37.2 and 46.5% of students and 22–24% of staff reported clinically significant anxiety and depression scores. Due to COVID-19, 33.8% of staff members reported low-stress levels (resilient), and 66.2% reported high-stress levels (classified as vulnerable). Among students, 71.7% exhibited resilience, while 28.3% lacked it. Staff members' social isolation and having children, as well as their gender and social isolation, were predictors of vulnerability. Exercise was shown to predict resilience in students and staff.

A study sought to determine whether health status and lost productivity in Japan were related to care disruptions during the COVID-19 state of emergency (Ishimaru et al., 2021). They found that individuals who had interrupted care or an aggravation of an underlying illness were more likely to have decreased productivity at work. An aggravation of the underlying disease was found to be substantially correlated with running out of medications and experiencing disruptions in both normal and non-routine clinical settings. In conclusion, employees who had their treatment interrupted were far more likely to report lower productivity. One potential method that interrupted care could impact productivity loss from presenteeism is aggravating the underlying illness. Maurício and Laranjeira (2023) investigated psychological discomfort, job satisfaction, presenteeism and related characteristics in a Portuguese worker working in a private social solidarity institution. Workers reported being absent due to illness in 38 cases (54.3%) and presenteeism in 32 cases (45.1%). Except for the income question, which generated a higher level of dissatisfaction (mean = 3.36 ± 1.9 pts.), the majority of the individual S20/23 evaluations showed a larger degree of satisfaction (mean > 4.5 pts.). Approximately 50.7% of participants were at high or extremely high risk of experiencing a mental illness. Presenteeism and job satisfaction showed a strong positive link, while presenteeism and psychological distress showed a substantial negative correlation ($p < 0.01$), according to the correlation matrix. Five factors were identified as presenteeism predictors ($R2 = 0.358$): marital status, sleep quality, absenteeism due to illness, assessment of one's health, and psychological distress.

Furthermore, another study analysed the psychological determinants of presenteeism among workers in a private corporation in Portugal (Dinis et al., 2021). The effect of workers' Psychological well-being (PWB), as a sign of good mental health, mediating the influence of psychosocial determinants such as workplace environment and WLB on presenteeism, is documented. More precisely, PWB acts as a mediator between Resource Communication (RC) (i.e., providing sufficient resources and effective communication that are important for the workers) and total presenteeism. The direct effects of Aspects of the Job (YJ), which are potential causes of stress connected to the nature of the job, and Work-Life Balance (WLB), which is the potential spill over or interference between work and individual or family life, tend to decrease when the mediated variable (PWB) is present. Absolute presenteeism is directly impacted by job security, albeit adversely. Abu-elenin (2021) investigated the acute psychological effects of the COVID-19 outbreak on Egypt's front-line physicians. It was found that 237 doctors participated in the study; their average age was 38.2 ± 6.2 years, and 58% were men. In total, anxiety and depression symptoms were reported by 78.9% and 43.8% of the participating physicians respectively. Anxiety risk was significantly higher in 85% of respondents' children (OR = 20.2). This study found a number of significant mediation factors for the observed depressive symptoms (OR = 0.51,1.39,0.56,1.9) and anxiety (OR = 0.53,3.28,0.18,1.56 respectively), including exposure to stigma related to COVID-19, poor sleep quality, being a resident physician, and interrupted social life. However, working in isolated hospitals did not significantly contribute to the problem.

2.10 Research gaps, chapter summary and conclusion

After extensive research, studies reporting on the effect of COVID-19 and Hypertension (high blood pressure) need to be more extensive. However, there was extant literature on COVID-19 and hypertension among patients. Considering that HCWs who contract COVID-19 are categorized as COVID-19-positive patients, studies reporting on COVID-19 and hypertension among patients were used as proxies for HCWs. Furthermore, studies reporting on the relationship between lifestyle choices and physical activity and COVID-19 health outcomes, to the best of the researcher's knowledge, could be more extensive. However, there are extant studies on the subject matter among patients who have contracted COVID-19. It also needs to be added that most of these studies reported their findings during the pandemic; thus, patients' lifestyles and physical activities were considered confounding factors that could influence patients into contracting COVID-19.

Heterogeneity is a significant element that may impact the studies' findings. Thus, most of the studies reported their findings by using patients as proxies for HCWs and a few times, HCWs were used for the intended purpose. Some studies' timing may also need to be fixed because it may have generalised the HCW population. At the same time, individuals may still need to report health outcomes. Thus, the studies on health outcomes among HCWs were done retrospectively. Certain studies done early in the pandemic may not present a clear picture of the extent of health outcomes before issues become serious. Most of the studies considered for this study were cross-sectional designs, and the primary gap with this type of research design is the absence of participant follow-up. Most of these studies were done at the height of the pandemic, which may have limited the participant's ability to generalize their responses when asked about their thoughts on the study under investigation.

Generally, the majority of the studies used cross-sectional surveys and secondary data, and others used cohorts and meta-analyses. It was also observed that most of the articles used were conducted out of Ghana due to the limited articles available in the field of study, particularly the health impact of COVID-19 post-recovery among HCWs in three referral hospitals in the Greater Accra Region, Ghana.

Furthermore, most of the studies adopted a retrospective design to reach conclusions on the health outcomes. These findings could miss some confounders, which could influence the findings. Also, factors leading to the health outcomes have nothing to do with the pandemic. To add to this, studies that adopted prospective cohort study designs were mostly undertaken in developed countries whose geographic settings differ from Ghana's. During the pandemic's peak, the number of cases recorded and the severity of the cases reported differed from the situation in Ghana as well. Thus, the present study sought to replicate such findings using the ambi-directional cohort study design.

Treating participants respectfully and neutrally is critical to performing a fair and objective study. The participants received enough explanation as to why it was crucial to do more research using this study design (ambi-directional) and how the distinction between what has and has not been successful in treating health outcomes associated with COVID-19 was made using the study's outcomes.

The literature reviewed in this study assessed the risk factors associated with COVID-19-related complications among HCWs of different socio-economic backgrounds and geographic location. These were done to make informed decisions on policy direction on protecting HCWs against future infections while administering care for the infected. The policy must be backed by evidence; hence, findings from this study proved that HCWs were also exposed to infections and needed to be protected.

Most of the studies cited in this literature review employed a quantitative approach to examining risk factors associated with COVID-19 among HCWs and patients. A few others used a mixed-method approach, administering questionnaires and conducting interviews. The literature reviewed here showed that many studies had been conducted on COVID-19 and health outcomes among HCWs.

To the best of my knowledge, this study is the first to assess the health impact of COVID-19 post-recovery among HCWs. It uses the ambi-directional study design in multiple health facilities. The findings will likely be significant to the Ghana Health Service (GHS) and the Ministry of Health in improving frontline HCWs' service conditions to ensure optimum protection, which can reduce re-infection and stigmatization.

CHAPTER THREE

METHODOLOGY

3.1 Study Design

An ambi-directional cohort study was undertaken to determine the impact of COVID-19 on healthcare workers' health and work output. This design was vital as it combines the strength on both retrospective and prospective cohort studies, allowing for a more comprehensive assessment of exposure-outcome relationships over time. Healthcare workers who had tested positive for the disease and recovered within one month (1st September- 30th September) were considered as the exposed group, while the unexposed group was healthcare workers who had tested negative for COVID-19 based on a laboratory-confirmed Reverse- Transcriptase Polymerase Chain Reaction (R-T PCR) test. Both groups were recruited from the Hospital's health records. Data on the experiences of the exposed group and how they were being managed for COVID-19 were taken retrospectively. These two groups were then followed up for 6 months. Follow-up assessments were done at baseline (Month 0), i.e. October 1st-31st, 3rd month (January 1st-31st), and 6th month (April 1st -30th). The assessment included blood pressure monitoring to determine the effect of the disease on the cardiovascular system, psychological assessment, work output (presenteeism), and spirometry to determine lung function. For the psychological effect, depression, anxiety, and stress were assessed. These expected outcomes were compared among the exposed and unexposed groups to determine the effect of COVID-19 on healthcare workers post-recovery.

3.2 Study area

The study was undertaken in the following Ghana Health Service hospitals: Tema General Hospital, Achimota Hospital, Greater Accra Regional Hospital, and Shai-Osudoku District

Hospital. These hospitals also served as main treatment centres for COVID-19, and many of their HCWs were infected with COVID-19.

3.2.1 Tema General Hospital

The Tema General Hospital is a secondary health care facility located in the Tema Central Constituency under the Tema Municipal Assembly of the Greater Accra region, which provides 24-hour medical service. William Jackson and Sons Limited established Tema General Hospital in 1954 to house labourers building Tema Harbour. The government later took ownership of the facility for public use. The Hospital is one of the busiest in the nation because of its geographic location, surrounding road system, commercial nature of the metropolis and the fact that it serves numerous catchment areas, including Kpone, Ashaiman, Sakumono, Lashibi, Nungua, Teshie, Dawhenya, Prampram, Ada, Ningo, Sege, and Dawa. It serves as the primary point of referral for all other clinics and hospitals in the city as well as the initial point of contact for the majority of countless traffic accidents, particularly those that occur on the highway and other industrial accidents. With a bed capacity of 319, Tema General Hospital comprises 21 distinct units, including an intensive care unit and internal medicine, general surgery, physiotherapy, obstetrics and gynecology, and specialty clinics like diabetic and sickle cell clinics.

The Hospital has 110 doctors, 10 pharmacists, 10 laboratory technicians, 403 nurses, and 3 health administrators. The authority structure of the Tema General Hospital flows vertically, thus from the administration headed by the Medical Director down to the lowest-ranking staff. The Hospital has a daily Outpatient Department (O.P.D) attendance of about 650 patients and an average bed occupancy rate of 85-90%. As part of the government's preparedness for the Ebola outbreak in 2014, Tema General Hospital was chosen to provide care if the country recorded a case. This site was chosen as it conducted mass COVID-19 testing for its staff, out of which quite a number of its health workers tested positive for COVID-19.

3.2.2 Greater Accra Regional Hospital

Originally founded in 1928 as a hospital for European expatriates, the Greater Accra Regional Hospital (GARH), also known as Ridge Hospital and Ridge Regional Hospital, is located at North Ridge in the Osu Clottey District of the Accra Metropolitan Area in the Northern Region of Ghana. With a projected population of 4,671,363 based on the 2016 forecast based on the 2010 Ghana Statistical Service census, the region as a whole serves as the hospital's catchment area. The hospital was considered for expansion and modernization within the government's endeavor to enhance the healthcare system and achieve universal health coverage. As a result, the Ghanaian government, the Export-Import Bank of Africa (EXIM BANK), and the British bank HSBC signed a contract to construct a state-of-the-art facility with roughly 620 beds and all the specialized services needed to fully satisfy the region's increasing need for tertiary level healthcare.

The state-of-the-art facility, which is currently fully operational, features several amenities, including an ultramodern 420-bed capacity, a comprehensive diagnostic and treatment block with a 24-hour surgery department, a delivery unit, an accident and emergency unit, a staff accommodation facility with 42 rooms, a school of anesthesia, a new mortuary, and an administration and support service wing with stores, transportation, maintenance, food service, and a waste treatment plant. To comply with environmental regulations, a portion of the building's electrical supply is generated by solar energy. Two backup generators with a combined 5600KVA capacity are added to these. The Hospital uses a paperless system at the moment.

The additional bed capacity that will house the outpatient department, catheterization laboratory, fertility center, specialized medical diagnostic service, public cafeteria and mini-mart, auditorium, dental, ophthalmology, ENT department, physiotherapy, psychiatry, and public health services is part of phase two, which is still under construction. Additionally, additional and alternative cooperative services will be offered. With all of this, the bed capacity will reach 620.

According to its human resource requirements and projections, the Hospital's mechanized payroll has a staff strength of 654. Ridge Hospital was part of the study site as it is one of the COVID-19 treatment centers and one of the hospitals where most health workers had mass testing for COVID-19.

3.2.3 Shai-Osudoku Hospital

Additionally, the Dodowa Hospital and the Shai-Osudoku District Hospital hosted the study. In 1970, this building was first used as a clinic. After that, in 1985, it was converted into a health center, and in 2009, it became a district hospital with 51 beds overall. The utilization of services increased accordingly, reaching its high in 2012. As a result, the government of Ghana replaced the old facility with an extended, ultra-modern 120 beds that it created in collaboration with the United Kingdom's Network Management Systems Infrastructure Limited. Use of the new facility began in July 2016. The Hospital serves as a trial site for national policy initiatives frequently. The hospital is located in Dodowa, the Shai-Osudoku District's capital. The district is bordered to the northwest by the Yilo-Krobo District, to the northeast by the North-Tongu District, to the west by the Akwapim-North District, to the southwest by the Tema District, and the south by the Atlantic Ocean. The district's population is predicted to be 62,668 as of the 2012 population and housing census, representing a 3.1% annual growth rate compared to the around 2.91 % annual growth rate for the entire country. Although this demographic makes up the majority of the hospital's patient base, immigrants and patients from nearby districts have also been using the institution for medical care. Presently, the establishment employs 157 service professionals, comprising, among others, 12 midwives, 45 enrolled nurses, 50 registered general nurses, 3 physician assistants, 2 dentists, and 2 nurse anaesthetists. Not only do seven specialized nurses need to be employed in public health, but also in pediatrics, otorhinolaryngology, and perioperative nursing, including a specialist. This setting was chosen as it conducted mandatory COVID-19 testing for its staff, out of which quite a number of its healthcare workers tested positive for the disease**.**

3.2.4 Achimota Hospital

The Accra Metropolitan Health Area includes the Okaikoi North Municipality, which includes the Achimota Health Zone. It includes the Achimota School neighbourhood, Kissieman, Christian Village, and Anunmle and is located in Accra's western region. Ten (10) years after the founding of the school, the Achimota School administration founded Achimota Hospital in 1927. Located inside the Achimota School, it was first constructed to serve the medical requirements of the faculty, staff, and other organizations in the surrounding region, including the Presbyterian Boys' and Accra Girls' Secondary Schools. Since its founding, it has provided services that go beyond the immediate area and have grown to include family health, accident and trauma care, and complete obstetric care. The Hospital was designated as a public facility and turned over to the Ministry of Health in 1973. The majority of educational facilities both inside and beyond the catchment region are currently served by the hospital. In 1985, Achimota Hospital was designated as a District Hospital. Before the maternity unit was constructed in 2020 and in 2021, no further buildings were added. In accordance with national health policies that have been authorized by the Ministry of Health (MOH) and Ghana Health Service (GHS), the Hospital's objective is to deliver and responsibly manage comprehensive, accessible health services within the Okaikoi Sub-Metro, with a focus on primary healthcare.

The area is bounded on the North by Ayawaso (West Lands), on the South by the Accra-Kumasi road, on the East by Ayawaso District (Legon), and on the West by Ga East District (Dome). The catchment area is a mixed community with a projected population of 64,667 (as of 2020), 100% of the total population of Okaikoi North Municipal Assembly. With a bed capacity of 88, the Hospital provides the following services: 24 Hour Emergency Services, general Out-Patient Department (OPD) services, In-patient Services, obstetrics and gynaecological Services, Reproductive, Maternal, Newborn, and Child Health Services, General and Specialty Surgical Services, Pediatric Specialty Care, Pharmaceutical Services, Laboratory Services, Medical Imaging/X-Ray/ Ultrasound Services, Dental Services, Eye/Optical Care, Ear, Nose and Throat (ENT) Care, Diabetic Services, Nutritional Services, Mental Health and Rehabilitation Services, Physiotherapeutic Services, Clinical Psychology Services, and Anti-Retroviral and Therapeutic (ART) Care. The Achimota Hospital has been chosen as it conducted mandatory COVID-19 testing for its staff, out of which quite a number of its healthcare workers tested positive for the disease.

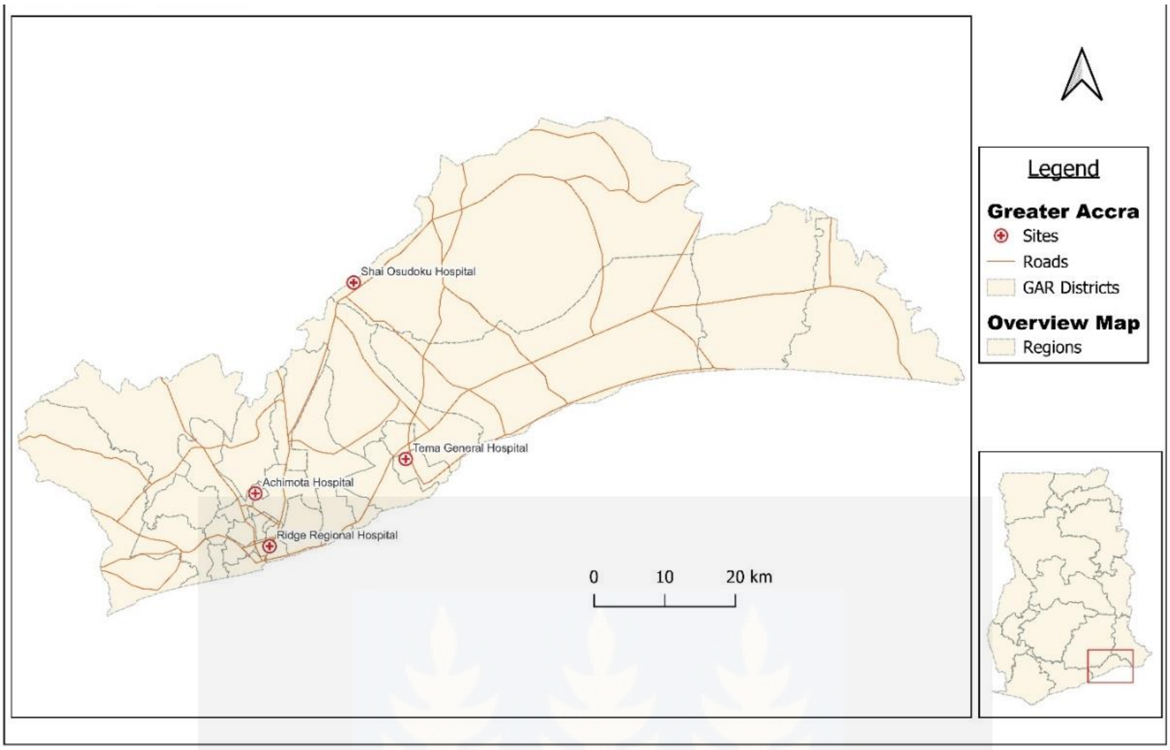

Figure 3.1 Map of the site for data collection on the impact of COVID-19 on the health and work output of healthcare workers

3.3 Study Population

The study population comprised Healthcare Workers (doctors, nurses, midwives, pharmacists, and laboratory scientists) who worked in hospitals that also served as COVID-19 treatment centers (Greater Accra Regional Hospital, Tema General Hospital, Achimota Hospital, and Shai Osudoku District Hospital, who had tested positive for COVID-19 infections and had recovered after being confirmed negative for RT-PCR test. This population was considered the exposed group. A reference population (unexposed group) who tested negative for COVID-19 after an RT-PCR test was done was also selected from the same hospital.

3.3.1 Inclusion Criteria

- Healthcare workers who had done a COVID-19 RT-PCR test and were either laboratory-confirmed positive and had recovered within 1 month (exposed group) or tested negative (unexposed group) within 1 month
- Healthcare workers who were permanent staff of the Hospital
- Healthcare workers who were present during the 6month data collection period
- Healthcare workers who consent to be part of the study.

3.3.2 Exclusion criteria

- Healthcare workers whose COVID-19 infection status was confirmed with other aside COVID-19 RT-PCR tests. eg. Rapid Diagnostic Test.
- Individuals doing their clinical rotation or internship
- Healthcare workers who had health-related issues, e.g. Psychosis, confirmed by the hospitals, making it impossible to interview them.
- Healthcare workers who did not consent to be part of the study.

3.4 Study Variables

3.4.1 Dependent Variables

The primary outcomes are COVID-19 health outcomes (blood pressure, lung function parameters (force vital capacity (FVC), forced Expiratory Volume at the first second of exhalation (FEV1), and the ratio of forced exhalation Volume in 1 second and Forced Vital Capacity (FEV1/FVC) and psychological outcomes such as depression, stress, and anxiety) and work output. These health outcomes were measured using standards used in clinical practice.

Table 3.1: Operational definitions of the dependent variable

Variable	**Definition**	**Scale of measurement**
a. Psychological health	Depression, anxiety, and stress were measured using the DASS-21	Categorical (normal, moderate, or severe)
b. Blood pressure	1. Systolic blood pressure (SBP) of 140 mmHg and above or Diastolic blood pressure (DBP) of 90 mmHg and above	Continuous (Systolic and diastolic)
	2. Hypertension (BP-140/90mmHg or more)	Binary (normal or high)
c. Lung function	a. Forced Expiratory Volume in the first-second (FEV_1)	a. Continuous
	b. Forced Vital Capacity (FVC)	b. Continuous
	c. The ratio of FEV_1 and FVC less than 70 was considered to reduce lung function	c. Binary (reduced or high)

Presenteeism	Presenteeism was measured using the Sanford Presenteeism scale. Low presenteeism was defined as participants with a presenteeism composite score of at most 15 on a scale of 6 to 30; otherwise, they were considered to have high presenteeism.	Binary (Low or high)

3.4.2 Independent Variables

The primary independent variable was the COVID-19 infection status of the participants, defined as having had the infection and recovered, or never tested positive for COVID-19 after confirmation with RT-PCR. Socio-demographic characteristics such as age, sex, educational level, religion, and several dependents were considered confounders, while the remaining independent variables included those variables that could interact/mediate with the relation between Exposure to COVID-19 and the dependent variables. These included professional characteristics (place of work, profession, department of work, other places of work aside the primary work, years of work experience, and net monthly salary), history of comorbidities such as diabetes, hypertension etc., lifestyle/physical activities, COVID-19 Clinical characteristics such as case management of the disease (the period between testing for the infection and release of the results, the severity of the disease, length of disease management, treatment regimen etc.) and Occupational/family support were also assessed.

Table 3.2: Operational definitions of independent variables

Variable	Definition	Scale of measurement
Exposure to COVID-19	HCWs COVID-19 infection status	Binary (COVID-19 and no COVID-19)
Personal/family history of comorbidities	Type of personal or family history of disease eg. Hypertension, diabetes, etc.	Binary (Yes or No)
Lifestyle/Physical activity	Exercising, smoking, and alcohol consumption habits of HCWs	Binary (Yes or No)
Family/Occupational support	Assessing if HCWs receive support both in their family and workplace	Binary (Yes or No)

3.5 Sample Size Determination

No sample size calculation was done for this study. A census was done to include all 252 who had the COVID-19 infection and had recovered (exposed group), and 504 HCWs who never had the COVID-19 infection (unexposed group), and met the inclusion criteria, making the total number of participants for the study 756. Census was used as it is the gold standard for data collection and the number of participants in the setting was manageable. This helped reduce selection bias. The exposed-to-unexposed ratio was 1:2. This was necessary so that in the event those in the unexposed group became exposed, the study still maintained a power of 80%.

3.6 Sampling Method

While all those 254 HCWs who had recovered from the disease (except two who were diagnosed with psychosis by the hospital) were considered for the study, a consecutive sampling method was used to recruit the participants in the unexposed group. To every HCW in the exposed group, two HCWs were also selected for the unexposed group. 165 (55 exposed, 110 unexposed) participants were recruited from the Greater Accra Regional Hospital, 213 (71 exposed, 142 unexposed) from the Achimota hospital, 120 (40 exposed, 80) unexposed) from the Tema General Hospital and 258 (86 exposed, 172 unexposed) from the Shai Osudoku hospitals. Purposive sampling was used in selecting these hospitals as they were treatment centres and had a lot of their HCWs being infected with COVID-19. This cohort was followed up for 6 months.

3.7 Data Collection Process

The field data collection was implemented in four (4) phases: (i) training of field workers, (ii) meeting with medical directors of the study sites, (iii) recruitment of participants, (iv) data collection **(see Figure 3.2**)

a. Training of field workers: A three-day training was provided to 12 field workers (six (6) registered general nurses, two (2) research assistants, and four (4) respiratory therapists) at the Greater Accra Regional Hospital's conference room from Monday to Wednesday between 10 am to 2 pm. On the first day, the field workers were taken through the dos and don'ts of the fieldwork, their responsibility during the project, as well as the ethical issues such as the rights of the study participants and techniques for the interview. On the second day, the field workers were taken through the practical session using the structured questionnaire to collect data from the respondents, using the spirometer and the blood pressure monitors (BP) for lung function and blood pressure, respectively. On the third day, the field workers were then assigned each of the following roles: 3 nurses, a research assistant, and 2 respiratory therapists were assigned to each of the hospitals to administer the questionnaire and check blood pressure, monitor lung function using the spirometer and report the findings after the spirometry is done.

b. Meeting with hospital medical directors: The research team met with the hospital medical directors and heads of clinical services to inform them of the project. During this period, a brief presentation was made to explain the objectives and methodology. Permission to carry out the project was sought. The heads of Public health at the various hospitals were nominated to lead the project during recruitment.

c. Recruitment of participants: Recruitment of participants was carried out by fieldworkers led by the head of public health at the Tema General, Achimota, Shai Osudoku, and Greater Accra Regional hospitals over four (4) weeks, starting with questions designed to check their eligibility. The purpose of the study was explained to healthcare workers who met the inclusion criteria, after which the date and time for the data collection were communicated to them. The total number of HCWs across the hospitals who had recovered within 1-month and met the inclusion criteria was 254. Of this, two were diagnosed with psychosis, making them ineligible to be part of the study, hence the total number who participated in the exposed group was 252.

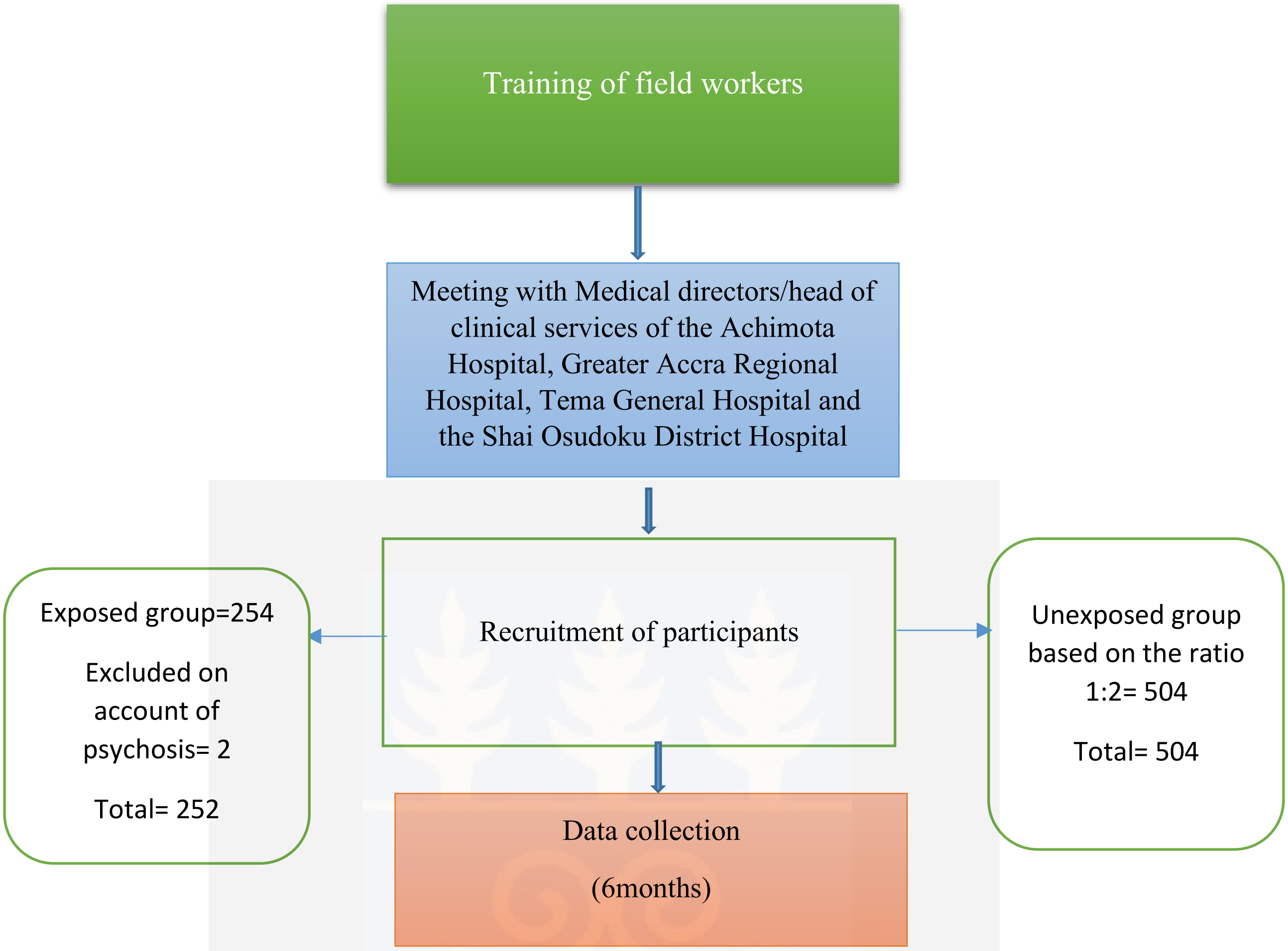

Figure 3.2: A Flow Chart Showing the Data Collection Process

3.7 Data Collection Procedure

Trained field workers, led by the Principal investigator, visited all the hospitals during the day and night shifts to ensure eligible HCWs are met. Data were collected from participants using an online structured questionnaire uploaded on the REDCap (Research Electronic Data Capture), hosted by the University of Ghana. The online questionnaire was divided into nine (9) sections: socio-demographic characteristics, family and personal history of comorbidities, lifestyle and physical activities among participants, clinical characteristics and management of COVID-19, family and occupational factors influencing health during the pandemic, psychological assessment, work output (presenteeism) assessment, lung function, and blood pressure assessments.

3.7.1 Psychological Assessment

Depression, Anxiety and Stress Scale

Healthcare professionals' psychological and stress levels were evaluated using the Depression, Anxiety and Stress Scale - 21 Items (DASS-21); a series of three self-report scales created to measure the emotional states of sadness, anxiety, and stress (Lovibond & Lovibond, 1995). Each of the three DASS-21 scales has seven items in total, broken down into subscales with comparable items. Dysphoria, hopelessness, life devaluation, self-deprecation, lack of interest or involvement, anhedonia, and inertia are all evaluated using the depression scale. The autonomic arousal, skeletal muscle effects, situational anxiety, and subjective experience of anxious affect are all measured by the anxiety scale. The chronic nonspecific arousal levels can be detected using the stress scale. It evaluates anxious arousal, inability to relax, irritability/over-reactivity, ease of getting upset or agitated, and impatience. The sum of the scores was used to determine the sadness, anxiety, and stress score. The tool reported high internal consistency within the Ghanaian context with Cronbach alpha: depression- 0.84-90, anxiety- 0.78-0.85 and stress- 0,80-0.89. In relation to validity DASS-21 correlates well with other mental health measures such as the GHQ-12 and PHQ-9.

Stanford Presenteeism Scale

The association between presenteeism, health issues, and productivity in working populations was evaluated using the Stanford Presenteeism Scale (SPS) (Koopman et al., 2002). Notwithstanding, health issues, a worker's capacity to focus and complete tasks is measured by this scale. With its assessments of cognitive, affective, and behavioural components of focus, the condensed version of the SPS perfectly captures the idea of presenteeism. This includes the procedures and results of work as well as the employee's assessment of their capacity to manage a health issue and still achieve work-related objectives. The tool, tested among academic staff in Ghana reported Cronbach's alpha values between 0.72 and 0.85, indicating a good internal consistency.

3.7.2 Pulmonary Function Test

A trained respiratory therapist from the University of Ghana Medical Centre Respiratory Unit performed spirometry for the pulmonary function. Spirometry was conducted using the Vitalograph Spirometer, consistent with the American Thoracic Guideline for Spirometry, 2019. The following parameters were measured: forced vital capacity (FVC), forced expiratory capacity at the first second of exhalation (FEV1), and the ratio of the forced vital capacity and the forced expiratory Volume at the first second of exhalation (FEV1/FVC). If obstruction was present, the spirometry measurements were repeated for analysis after administering a bronchodilator (2 puffs of salbutamol). All pulmonary function test measurements were expressed as percentages of predicted normal values.

3.7.3 Blood Pressure Monitoring

Trained Registered General Nurses with at least 2 years of experience conducted blood pressure monitoring. The blood pressure monitoring was done using a digital sphygmomanometer (Omron®). Energizer batteries were used and changed every 3 days to ensure accuracy in the blood pressure readings. Three different blood pressure cuff sizes were available, namely large adult, regular adult, and paediatric sizes, so that the appropriate cuff size for the respondent was applied. The procedure was explained to the respondents who were reassured to allay anxiety. They were encouraged to relax in a chair for at least 10 minutes as excessive movement could interfere with the blood pressure reading. The appropriate cuff size was wrapped snugly on the left upper arm with the participant's hand turned upward. The midpoint of the bladder length lay over the brachial artery and the mid-height of the cuff at the heart level. The start button was then pressed to start the reading. Three (3) different readings were taken at least 30 seconds apart. The average of the three readings was recorded as the true blood pressure. The measurement was then compared to the American Heart Association guidelines for diagnosing hypertension, as described in **Table 3.3**

Table 3.3.: Guidelines for Blood Pressure Measurement

Blood pressure category	Systolic mmHg (upper number)		Diastolic mmHg (lower number)
Normal	Less than 120	and	Less than 80
Elevated	120-129	and	Less than 80
High blood pressure (hypertension Stage 1)	130-139	or	80.89
High blood pressure (hypertension Stage 2)	140 or higher	or	90 or higher
Hypertensive crisis	Higher than 180	and	Higher than 120

(Source: American Heart Association, 2017)

3.8 Quality Assurance

The researcher also trained five nurses working in these facilities to ensure that they understood the research topic, objectives, the sensitivity of the topic, and the need for confidentiality before administering the questionnaires, checking the blood pressure, and conducting the spirometry with the primary research assistants. The training also ensured that they were adequately equipped to assist with the data collection. The Principal Investigator worked with and supervised the team during the entire period of the fieldwork.

3.9 Data Handling and Analysis

The data in the study were analysed using Stata IC version 16. Descriptive characteristics were performed by summarizing categorical variables using frequencies and percentages. Normally distributed continuous variables were analysed using mean and standard deviation, whiles non-normally distributed continuous variables were analysed using median and interquartile range.

3.9.1 Analysis of COVID-19 Exposure Status

A descriptive analysis was performed for all the samples, and the exposure status was compared. The Pearson chi-square test was used to compare the characteristics of the unconditional nature of the exposed group to the unexposed group. The Wilcoxon rank sum test was used to test equality in the median of non-normally distributed continuous variables between the exposed and the unexposed groups. Further descriptive analysis was performed among the exposed groups, describing the clinical and health management characteristics of COVID-19 vaccination status, sex of participants, and history of comorbidities among the participants. The fixed effect and mixed effect binary logistic regression model was used to assess the factors associated with exposure to COVID-19 among the healthcare workers adjusting for health facility level fixed effect. These regression models were used to under the within-groups variations as well as the account for hierarchical nature of the data.

3.9.2 Analysis of Psychological Health Outcomes

The psychological health outcomes considered in this study were depression, anxiety and stress. Each of the three psychological outcomes were categorical ordinal variables with 3 levels, namely (1) Normal, (2) Mild/moderate, and (3) Severe, derived from a composite score from the DASS21 scale. Each of the three outcomes was derived from a 7-item Likert scale question, with each question having four possible responses scoring from 0 to 3. For each psychological health outcome, the boxplot was used to describe the average composite scores between the exposed and the unexposed, estimating the median and interquartile ranges. The Wilcoxon rank sum test was used to compare the median composite score between the exposed and the unexposed at baseline, 3 months and 6 months after recruitment.

The composite scores were then categorized into 3 categories, and the percentage with normal, mild/moderate and severe psychological health outcomes were described between the exposed and the unexposed at baseline, month 3 and month 6 on a stacked clustered bar chart. The Pearson chi-square test was used to assess the association between the psychological health level and the exposure status at baseline, month 3 and month 6. The pattern of the psychological health outcomes from baseline to month 3 and then month 6 was described on a clustered bar chart between the exposed and the unexposed.

Further bivariate analysis for each of the three psychological health outcomes at baseline, month 3, and month 6 was performed against each of the independent categorical variables using the Pearson chi-square test. For the multivariable analysis, all variables (socio-demographic, work and professional-related, family and personal history of a comorbidity, lifestyle, family, and workplace support, and COVID-19-related characteristics) were considered for the final generalized ordered linear model. Variables with high multicollinearity (thus variance inflation factor (VIF) > 10) were, however, excluded (Appendix 4). The interaction between COVID-19 exposure status at baseline and time, as well as the interaction between COVID-19 status at baseline and variables that showed significant association with the psychological health outcomes, were included in the final multivariable generalized ordered linear model estimating the adjusted proportional odds ratios (APOR) and the corresponding confidence interval and p-values. The interaction between COVID-19 exposure and time on the outcome was important to understand the likely changes between baseline to endline.

3.9.3 Analysis of Other Health Outcomes

Blood Pressure, lung function, and presenteeism

The boxplot was used to describe systolic blood pressure (SBP), diastolic blood pressure (DBP), FEV_1, FVC, and FEV_1/FVC between the exposed and the unexposed at baseline, month 3, and month 6, estimating the median and the interquartile range. The Wilcoxon rank sum test was used to test the equality of the median between the exposed and the unexposed.

High blood pressure was defined as participants with systolic blood pressure (SBP) of 140 mmHg and above, and diastolic blood pressure (DBP) of 90 mmHg and above, based on at least accurate checks. Reduced lung function was described as participants with an FEV_1/FVC ratio below 0.70, defined as having reduced lung function. Low presenteeism was defined as participants with a presenteeism composite score of at most 15 on a scale of 6 to 30; otherwise, they were considered to have high presenteeism. The Pearson chi-square test was used to assess the association between the three outcomes (high blood pressure, reduced lung function, and presenteeism) and the exposure status at baseline, month 3, and month 6. The pattern of these outcomes from baseline to month 3 and then month 6 was also described on a clustered bar chart between the exposed and the unexposed.

Further bivariate analysis for each of the three outcomes (high blood pressure, reduced lung function, and presenteeism) at baseline, month 3, and month 6 was performed against the independent categorical variables using the Pearson chi-square test. For the multi-level generalized logistic regression analysis, all variables (socio-demographic, work and professional-related, family and personal history of a chronic condition, lifestyle, family and workplace support, and COVID-19-related characteristics) were considered for the final generalized binary logistic regression model. Seven models were generated after controlling for all potential confounding factors.

Variables with high multicollinearity (thus variance inflation factor (VIF) > 10) were, however, excluded. The interaction between COVID-19 exposure status at baseline and time, as well as the interaction between COVID-19 status at baseline and variables that showed significant association with the three outcomes, were included in the final multi-level generalized logistic regression model estimating the adjusted proportional odds ratios (APOR) and the corresponding confidence interval and p-values. In the case of presenteeism, the outcomes of depression level, anxiety level, stress level, high blood pressure, and reduced lung function were considered as exposure variables. All analyses in this study were considered statistically significant at an alpha level of 0.05.

3.10 Ethical Considerations

To ensure that the research met ethical standards, approval was obtained from the Ethical Review Committee (ERC) of the Ghana Health Service (GHS), Research and Development Division, Accra (GHS-ERC 003/03/21), after which the clinical Care department endorsed it before the study was conducted. The head of the Biological, Environmental, and Occupational

Health Sciences (BEOHS) department of the School of Public Health (SPH) issued a letter of introduction to the medical directors of the selected hospitals seeking permission to conduct the study. A memo was then distributed to the various wards by the medical directors through the unit heads, asking them to render their maximum cooperation for the study to be conducted.

3.10.1 Privacy and Confidentiality

To ensure privacy and confidentiality, the names of the participants were only known to the Principal Investigator and research assistants. The names were later replaced with unique identification numbers so the data could not be traced to the participants. The research assistants were also blinded to the COVID-19 exposure status of participants to control for interviewer bias. Answering the interview-based questionnaire was undertaken in an isolated area. The essence was to ensure secrecy. Respondents' names were not mentioned in the study report, and data collated from respondents was kept on a password-protected computer. The hard copies were kept under lock and key, with the key only kept by the Principal investigator.

3.10.2 Potential Risks and Benefits

Participants experienced minimal discomfort during blood pressure checks and when blowing air into the spirometer. This was explained to the participants before the procedure to decrease anxiety. The spirometer and the blood pressure cuff were decontaminated with diluted bleach after use by each participant. Given the risk posed by the COVID-19 pandemic, all safety directives and protocols about COVID-19, as recommended by the Ghana Health Service and the National COVID-19 control team to avoid the risk of being infected with the virus, were strictly adhered to. Participants were made to observe hygiene practices such as hand washing with soap under running water and using alcohol-based hand sanitizer. Again, the wearing of facemasks by the study participants, researcher and research assistants, as well as maintaining a social distance of at least 6 feet, was necessary during blood pressure monitoring and spirometry. Respondents did not gain any financial benefits, but were provided with the outcome of the final study. Also, the findings and conclusions that were arrived at could contribute to decision-making policies about the management of HCWs and the general population who have recovered from COVID-19. Findings from the blood pressure evaluation, psychological assessment, and lung function test that could influence the participants' well-being were shared with their healthcare providers to help in their management.

3.10.3 Compensation

Study respondents were not given any monetary compensation for participating in the study. This was made known to participants before they chose to participate.

3.10.4 Voluntary Withdrawal

Participation in the study was entirely voluntary. Respondents were free to withdraw from the study when they chose to, without any consequences whatsoever. In the event of a respondent's withdrawal, the researcher continued to use the information collected before the withdrawal to complete the research.

3.10.5 Informed Consent and Consenting Process

Respondents' consent was sought before the start of the research. Eligible participants were required to sign or place a thumbprint on the consent form after the study objectives and participants' roles were explained to them. They were also provided with information on contacting the Principal Investigator and the ethics review committee office. A copy of the informed consent form was given to them after they and the interviewers had signed.

3.10.6 Cost for Participation

Participants did not receive any compensation for participation.

3.10.7 Funding Information

The study was fully sponsored by the Principal investigator with BANGA Africa supporting the thesis completion

3.10.8 Declaration of Conflict of Interest

The Principal Investigator had no conflict of interest in the study's outcome.

3.10.9 Protocol Amendments

Ghana Health Service Ethics Review Committee was informed of all amendments to the protocol following changes/additions to the protocol and consent form.

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents the results after analysing the data gathered from the fieldwork. The chapter is presented in five sections. These include a descriptive presentation of respondents' socio-demographic characteristics, followed by the clinical characteristics of HCWs diagnosed with COVID-19. Also, the after-effects of COVID-19 on health outcomes (psychological health, blood pressure, lung function) among healthcare workers are presented. Furthermore, the effect of COVID-19 on work output among healthcare workers post-recovery is presented. Last but not least, the effect of health outcomes on work output among healthcare workers post-recovery is presented.

4.2 Socio-demographic Characteristics of Participants

A total of 756 HCWs participated in the study. Generally, the HCWs median age was 32 years (28-37), and close to half were 30 – 39 years (365/756, 48.3%). Most of the HCWs were females (587/756, 77.6%), had a bachelor's degree or higher (369/756, 48.8%), were Christians (660/756, 87.3%), married (411/756, 54.4%), and had no children (393/756, 52.0%). COVID-19 infection was higher in HCWs aged 30 – 39 years. In the exposed group, compared to the unexposed group (exposed vs unexposed: 49.6% vs 47.6%; $p<0.001$). Also, COVID-19 infection was significantly ($p<0.001$) higher in HCWs with bachelor's degree or higher in the exposed group (59.1%) than the unexposed group (43.7%). There was no significant difference between the sex of HCWs and their chance of being infected with COVID-19 between the two groups ($p=0.084$). Socio-demographic results are presented in Table 4.1.

Table 4.1: Socio-Demographic Characteristics of Participants by Exposure Status

Characteristics	Total N=756 n/N (%)	Unexposed N=504 n/N (%)	Exposed N=252 n/N (%)	p-value
Participant age, median (IQR)	32 (28 - 37)	31 (28 - 35)	34 (30 - 40)	<0.001
Age group (in years)				<0.001
20-29	259/756 (34.3)	197/504 (39.1)	62/252 (24.6)	
30-39	365/756 (48.3)	240/504 (47.6)	125/252 (49.6)	
40-49	90/756 (11.9)	51/504 (10.1)	39/252 (15.5)	
50-60	42/756 (5.6)	16/504 (3.2)	26/252 (10.3)	
Sex				0.084
Female	587/756 (77.6)	382/504 (75.8)	205/252 (81.3)	
Male	169/756 (22.4)	122/504 (24.2)	47/252 (18.7)	
Highest education				<0.001
Certificate	146/756 (19.3)	141/504 (28.0)	5/252 (2.0)	
Diploma degree	241/756 (31.9)	143/504 (28.4)	98/252 (38.9)	
Bachelor's degree or higher	369/756 (48.8)	220/504 (43.7)	149/252 (59.1)	
Religion				<0.001
Christian	660/756 (87.3)	446/504 (88.5)	214/252 (84.9)	
Muslim	71/756 (9.4)	35/504 (6.9)	36/252 (14.3)	
Others	25/756 (3.3)	23/504 (4.6)	2/252 (0.8)	
Marital status				<0.001
Never married	317/756 (41.9)	246/504 (48.8)	71/252 (28.2)	
Married	411/756 (54.4)	244/504 (48.4)	167/252 (66.3)	
Previously married	28/756 (3.7)	14/504 (2.8)	14/252 (5.6)	
Number of dependents, median (IQR)	0 (0 - 3)	0 (0 - 2)	2 (0 - 3)	<0.001
Number of dependents				<0.001
None	393/756 (52.0)	305/504 (60.5)	88/252 (34.9)	
1-2 dependents	158/756 (20.9)	104/504 (20.6)	54/252 (21.4)	
3-4 dependents	134/756 (17.7)	56/504 (11.1)	78/252 (31.0)	
5+ dependents	71/756 (9.4)	39/504 (7.7)	32/252 (12.7)	

4.3 Professional Characteristics of Participants

The majority of the participants in this study were from the Shai-Osudoku district hospital (258/756, 34.1%). Most of the HCWs were nurses (472/756, 62.4%), worked in the medical/Surgical department (285/756, 37.7%), had two or more part-time jobs (163/756, 21.6%), with less than 5 years' work experience (383/756, 50.7%), and earned a monthly salary between GHS 2001 – 3000 (429/756, 56.7%). Furthermore, HCWs with two or more other part-time jobs in the exposed group had a higher risk of being infected with COVID-19 compared to those in the unexposed group (81.2% vs 58.9%; p<0.001). The probability of being infected with COVID-19 decreased significantly (p<0.001) in HCWs with less than 5 years' work experience in the exposed group (42.5%) than those in the unexposed group (54.9%). The professional characteristics of respondents are presented in Table 4.2.

Table 4.1: Professional Characteristics of Study Participants by Exposure Status

Characteristics	Total N=756 (%)	Unexposed N=504 n/N (%)	Exposed N=252 n/N (%)	p-value
Health facility				1.000
Greater Accra Regional Hospital	165/756 (21.8)	110/504 (21.8)	55/252 (21.8)	
Shai-Osudoku district hospital	258/756 (34.1)	172/504 (34.1)	86/252 (34.1)	
Achimota hospital	213/756 (28.2)	142/504 (28.2)	71/252 (28.2)	
Tema General hospital	120/756 (15.9)	80/504 (15.9)	40/252 (15.9)	
Profession				0.630
Doctor	110/756 (14.6)	74/504 (14.7)	36/252 (14.3)	
Nurse	472/756 (62.4)	317/504 (62.9)	155/252 (61.5)	
Laboratory scientist	26/756 (3.4)	20/504 (4.0)	6/252 (2.4)	
Pharmacist	36/756 (4.8)	24/504 (4.8)	12/252 (4.8)	
Midwives	112/756 (14.8)	69/504 (13.7)	43/252 (17.1)	
Department				0.350
Medical/Surgical	285/756 (37.7)	187/504 (37.1)	98/252 (38.9)	
Emergency/ICU	131/756 (17.3)	93/504 (18.5)	38/252 (15.1)	
OBS & GYN	118/756 (15.6)	79/504 (15.7)	39/252 (15.5)	
Child health	88/756 (11.6)	51/504 (10.1)	37/252 (14.7)	
OPD	73/756 (9.7)	49/504 (9.7)	24/252 (9.5)	
Pharmacy	35/756 (4.6)	24/504 (4.8)	11/252 (4.4)	
Laboratory	26/756 (3.4)	21/504 (4.2)	5/252 (2.0)	
Number of part-time jobs				<0.001
None	502/756 (66.4)	297/504 (58.9)	205/252 (81.3)	
One	91/756 (12.0)	50/504 (9.9)	41/252 (16.3)	
Two+	163/756 (21.6)	157/504 (31.2)	6/252 (2.4)	
Years worked, median (IQR)	4 (2 - 9)	4 (2 - 8)	5 (2 - 10)	0.014
Years Worked				0.013
<5 years	383/755 (50.7)	276/503 (54.9)	107/252 (42.5)	
5-9 years	201/755 (26.6)	121/503 (24.1)	80/252 (31.7)	
10-14 years	125/755 (16.6)	79/503 (15.7)	46/252 (18.3)	
15+ years	46/755 (6.1)	27/503 (5.4)	19/252 (7.5)	
Net monthly salary				<0.001
<Ghc 1000	15/756 (2.0)	6/504 (1.2)	9/252 (3.6)	
Ghc 1001-2000	131/756 (17.3)	84/504 (16.7)	47/252 (18.7)	
Ghc 2001-3000	429/756 (56.7)	311/504 (61.7)	118/252 (46.8)	
> Ghc 3000	181/756 (23.9)	103/504 (20.4)	78/252 (31.0)	

4.4 Results for specific objective 1: Clinical characteristics and management of COVID-19 among HCWs diagnosed with the disease

4.4.1 Clinical Characteristics of Participants

The majority of the HCWs reported not having a family history of comorbidities, with those with a positive family history reporting hypertension and diabetes. Ninety-eight (38.9%) reported a family history of hypertension, while fifty (19.8%) reported diabetes. There was a higher association among HCWs with a family history of diabetes HCWs in the exposed group than in the unexposed group (50/252, 19.8% vs. 33/504, 6.5%). The commonest comorbidities among the HCWs were hypertension and Asthma (1.6%), respectively, and diabetes (3.2%). There was no significant association between a history of comorbidities among the HCWs and the risk of exposure to COVID-19.

Over one-third of the participants (277/756, 36.6%) tested four or more times for COVID-19, as it was a hospital policy for all the staff to be screened (308/756, 40.7%). The number of tests done was significant (p<0.001), with many doing it in the unexposed group than in the exposed group. Most HCWs received their COVID-19 test results within 72 hours (383/755 (50.7%). Signs and symptoms exhibited were significant (p<0.001), with the commonest being cold (68/252, 27.0%), cough (63/252, 25.0%), loss of taste (60/252, 23.8%), fever (59/252, 23.4%), headache (57/252, 22.6%) and fatigue (53/252, 21.0%). The exhibition of these signs and symptoms was higher in the exposed group.

Vaccination status among the HCWs was not significant (p=0.24), with the majority in the unexposed group having received a full dose of the vaccination compared to those in the exposed group (340/504, 67.5% vs 188/252, 74.6%). Thirteen per cent of the HCWs in the exposed group, however, tested positive again even after being vaccinated against COVID-19. Details are presented in Table 4.3.

Table 4.2: Clinical Characteristics of Participants

Characteristics	Total N=756 n/N (%)	Unexposed N=504 n/N (%)	Exposed N=252 n/N (%)	p-value
Family history of comorbidity				<0.001
No	475/756 (62.8)	354/504 (70.2)	121/252 (48.0)	
Yes	281/756 (37.2)	150/504 (29.8)	131/252 (52.0)	
Family history of hypertension	216/756 (28.6)	118/504 (23.4)	98/252 (38.9)	<0.001
Family history of diabetes	83/756 (11.0)	33/504 (6.5)	50/252 (19.8)	<0.001
Personal history of comorbidity	51/756 (6.7)	30/504 (6.0)	21/252 (8.3)	0.220
Hypertension	18/756 (2.4)	14/504 (2.8)	4/252 (1.6)	0.310
Asthma	12/756 (1.6)	8/504 (1.6)	4/252 (1.6)	1.000
Diabetes	16/756 (2.1)	8/504 (1.6)	8/252 (3.2)	0.150
Mental illness	4/756 (0.5)	1/504 (0.2)	3/252 (1.2)	0.076
Sickle cell disease	3/756 (0.4)	1/504 (0.2)	2/252 (0.8)	0.220
Renal disease	1/756 (0.1)	0/504 (0.0)	1/252 (0.4)	0.160
Liver disease	0/756 (0.0)	0/504 (0.0)	0/252 (0.0)	
Number of COVID-19 tests done				<0.001
Once	256/756 (33.9)	174/504 (34.5)	82/252 (32.5)	
Twice	148/756 (19.6)	74/504 (14.7)	74/252 (29.4)	
Thrice	75/756 (9.9)	61/504 (12.1)	14/252 (5.6)	
Four or more	277/756 (36.6)	195/504 (38.7)	82/252 (32.5)	
Reason for testing				<0.001
Exhibiting signs and symptoms	170/756 (22.5)	83/504 (16.5)	87/252 (34.5)	
Just decided to get tested	52/756 (6.9)	43/504 (8.5)	9/252 (3.6)	
Was exposed to a COVID-19 patient	226/756 (29.9)	141/504 (28.0)	85/252 (33.7)	
Facility policy to get tested	308/756 (40.7)	237/504 (47.0)	71/252 (28.2)	
Symptoms exhibited				
Fever	101/756 (13.4)	42/504 (8.3)	59/252 (23.4)	<0.001
Difficulty in breathing	51/756 (6.7)	19/504 (3.8)	32/252 (12.7)	<0.001
Cough	101/756 (13.4)	38/504 (7.5)	63/252 (25.0)	<0.001
Cold	110/756 (14.6)	42/504 (8.3)	68/252 (27.0)	<0.001
Loss of taste	95/756 (12.6)	35/504 (6.9)	60/252 (23.8)	<0.001
Loss of smell	86/756 (11.4)	33/504 (6.5)	53/252 (21.0)	<0.001
Headache	96/756 (12.7)	39/504 (7.7)	57/252 (22.6)	<0.001
Fatigue	87/756 (11.5)	34/504 (6.7)	53/252 (21.0)	<0.001
Diarrhoea	11/756 (1.5)	4/504 (0.8)	7/252 (2.8)	0.032
How long it took to receive COVID-19 test results				<0.001
Within 72 hours	383/755 (50.7)	302/503 (60.0)	81/252 (32.1)	
1 to 2 weeks	236/755 (31.3)	135/503 (26.8)	101/252 (40.1)	
2-4 weeks	96/755 (12.7)	46/503 (9.1)	50/252 (19.8)	
More than a month	40/755 (5.3)	20/503 (4.0)	20/252 (7.9)	
Ever vaccinated against COVID-19				0.024
Yes, full dose	528/756 (69.8)	340/504 (67.5)	188/252 (74.6)	
Yes, a partial dose	123/756 (16.3)	95/504 (18.8)	28/252 (11.1)	
No	105/756 (13.9)	69/504 (13.7)	36/252 (14.3)	
Have you ever tested positive after vaccination?				<0.001
No	622/651 (95.5)	435/435 (100.0)	187/216 (86.6)	
Yes	29/651 (4.5)	0/435 (0.0)	29/216 (13.4)	

4.4.2 Management of COVID-19 Infection among HCWs diagnosed with the disease

The management of COVID-19 infection among healthcare workers (HCWs) was assessed in this study. Most (87.7%) HCWs experienced a mild form of COVID-19 and did not require hospitalization. However, 7.5% of the respondents encountered a moderate to severe form of the disease, requiring hospital admission without supplementary oxygen, while a minimal proportion of the participants (2.4%) suffered from severe COVID-19, requiring hospitalization and oxygen support (Figure 1). Clinical investigations following COVID-19 infection were primarily comprised of Full Blood Count (46.4%), Chest X-ray (21.4%), Blood Urea and Creatinine tests (19.8%), and Liver Function Test (LFT) (17.1%) (Figure 2). In terms of treatment, the majority of HCWs resorted to vitamin C and Zinc supplements (67.9%) and azithromycin (64.3%) (Figure 3). Additionally, over 50% of HCWs supplemented orthodox medicine with herbal remedies, specifically neem tree concoctions and steam inhalation (Figure 4). These findings shed light on the varied management approaches employed by HCWs following COVID-19 infection.

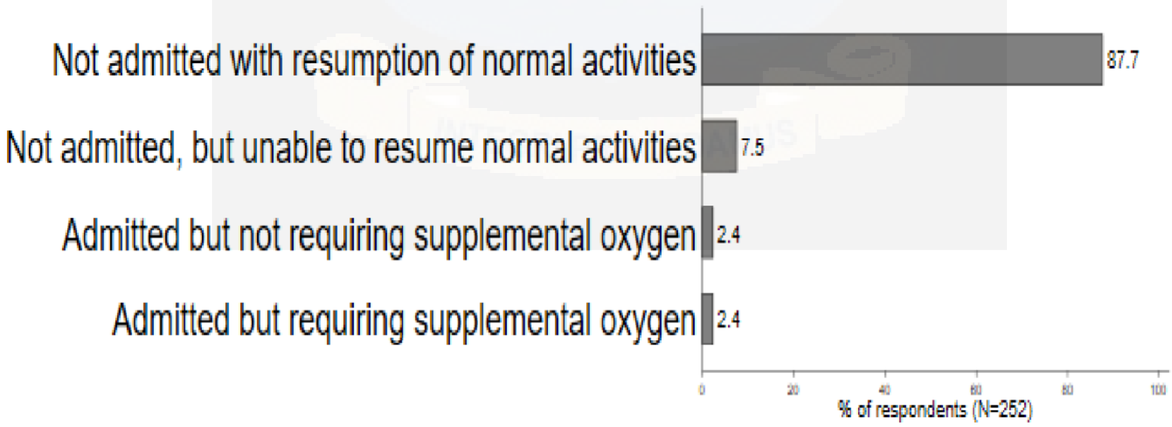

Figure 4.1: COVID-19 Severity among the HCWs

***Footnote: Not admitted with resumption of normal activities** – Not severe COVID-19

***Not admitted, but unable to resume normal activities/ admitted but not requiring supplemental oxygen- moderate-**severe COVID-19

***Admitted but requiring supplemental oxygen** –Severe COVID-19

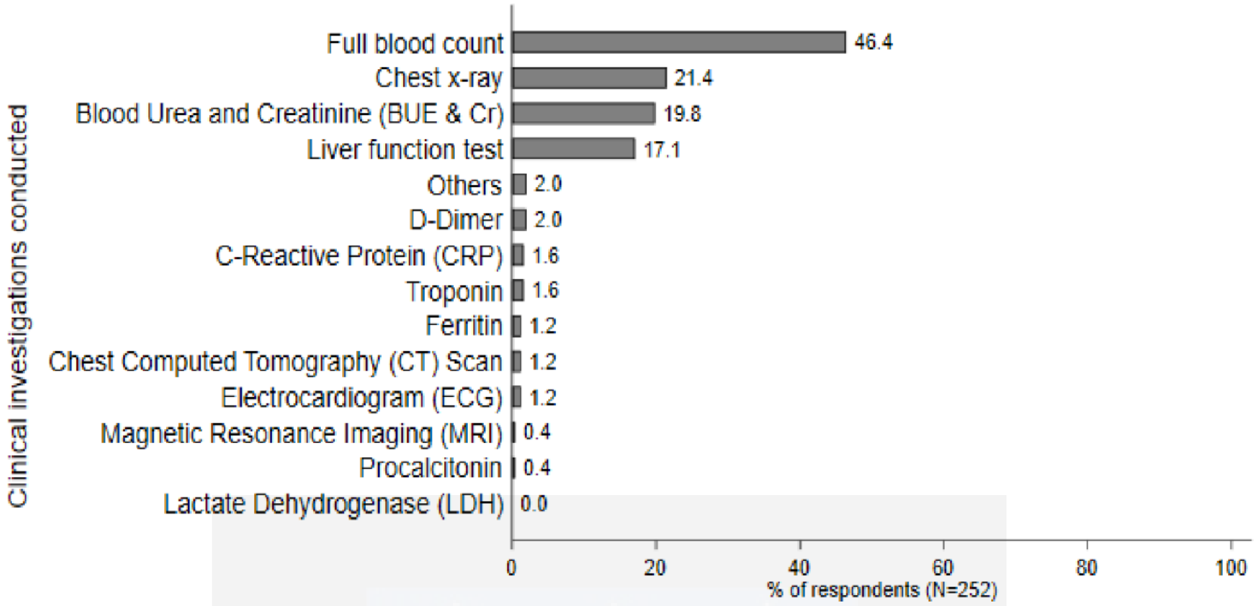

Figure 4.2: Laboratory investigations conducted among the respondents

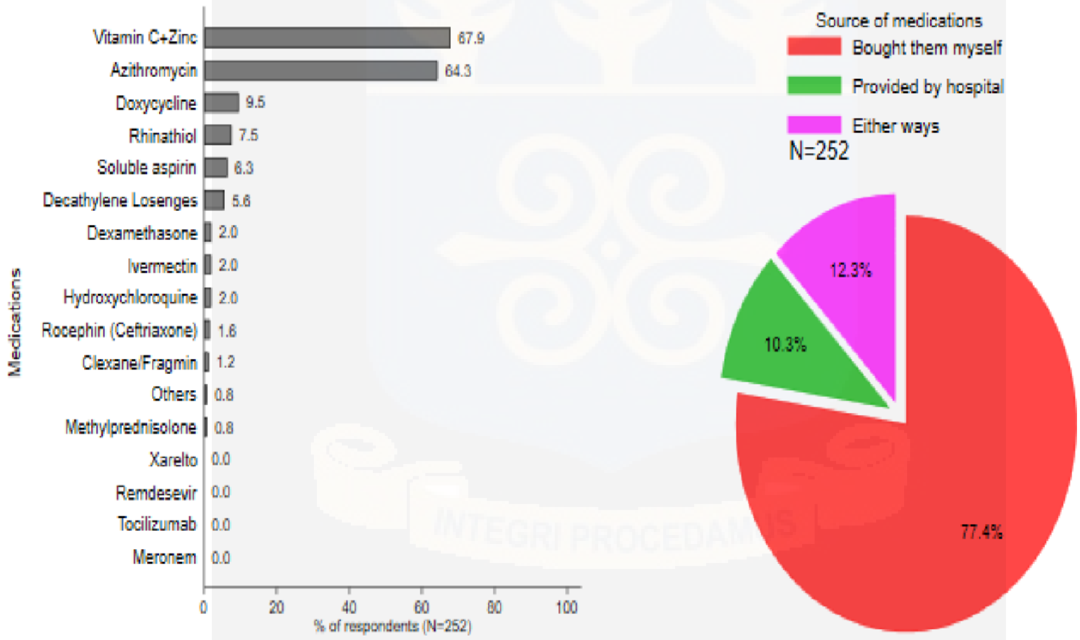

Figure 4.3: Medications and source of medication for COVID-19 treatment among respondents

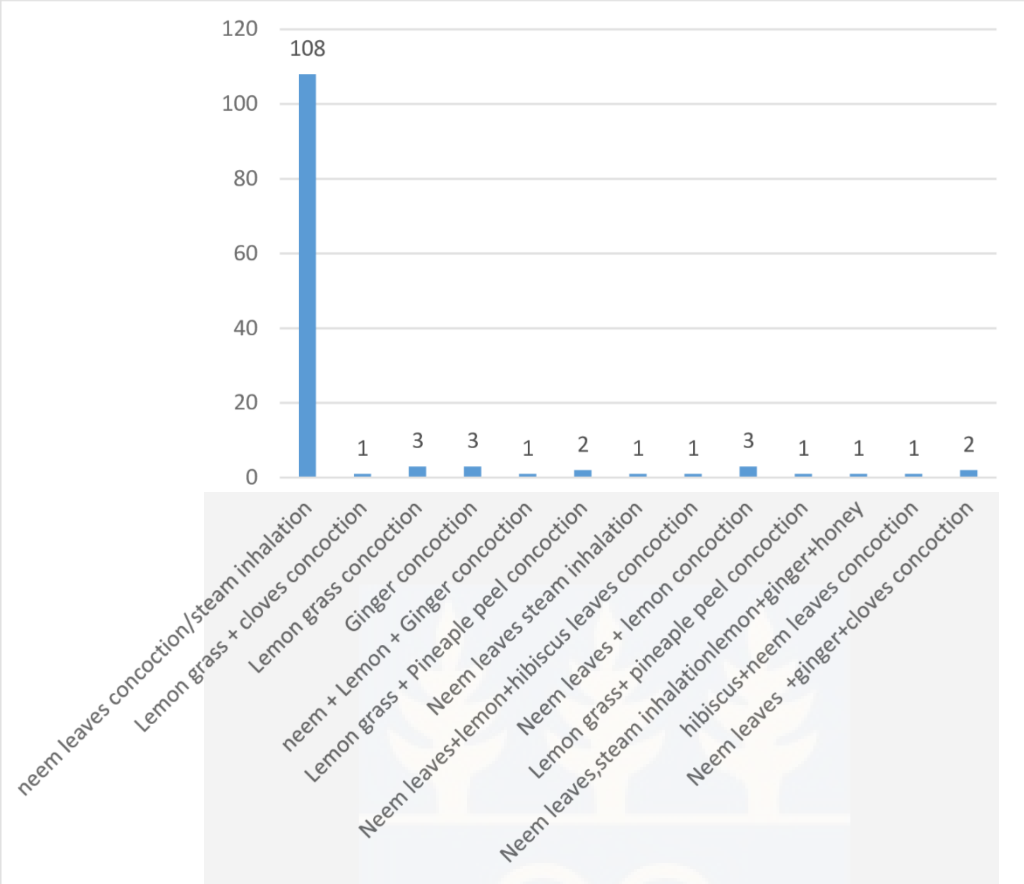

Figure 4.4: Use of herbal medications for COVID-19 treatment among the respondents

4.4.3 Relationship between Clinical Characteristics of HCWs and COVID-19 Disease Severity

The association between clinical characteristics of healthcare workers (HCWs) and the severity of COVID-19 infection was investigated. Among the variables examined, a personal history of comorbidity ($p<0.0041$) and a history of smoking ($p<0.001$) were found to be significantly associated with the severity of COVID-19 infection. However, a history of alcohol intake showed borderline significance in COVID-19 infection severity (Table 4.4).

Table 4.3: Relationship between COVID-19 Clinical Characteristics and Disease Severity

		Severity			
Overall	Total N=252	Not severe N=221	Moderately severe N=19	Severe N=12	P-value
Characteristics	**N (%)**	**N (%)**	**N (%)**	**N (%)**	
Participant age, median (IQR)	34 (30 - 40)	34 (30 - 40)	33 (29 - 38)	39(30.5-54)	0.150
Age group (in years)					0.110
20-29	62/252 (24.6)	54/221 (24.4)	5/19 (26.3)	3/12 (25.0)	
30-39	125/252 (49.6)	109/221 (49.3)	12/19 (63.2)	4/12 (33.3)	
40-49	39/252 (15.5)	36/221 (16.3)	2/19 (10.5)	1/12 (8.3)	
50-60	26/252 (10.3)	22/221 (10.0)	0/19 (0.0)	4/12 (33.3)	
Sex					0.170
Female	205/252 (81.3)	176/221 (79.6)	18/19 (94.7)	11/12(91.7)	
Male	47/252 (18.7)	45/221 (20.4)	1/19 (5.3)	1/12 (8.3)	
Highest education					0.210
Certificate/Diploma	102/252 (40.5)	94/221 (42.5)	5/19 (26.3)	3/12 (25.0)	
Bachelor's degree or higher	150/252 (59.5)	127/221 (57.5)	14/19 (73.7)	9/12 (75.0)	
Department					0.840
High risk*	67/252 (26.6)	59/221 (26.7)	6/19 (31.6)	2/12(16.7)	
Low risk	185/252 (73.4)	162/221 (73.3)	13/19 (68.4)	10/12(83.3)	
Family history of comorbidity					0.120
No	121/252 (48.0)	106/221 (48.0)	12/19 (63.2)	3/12 (25.0)	
Yes	131/252 (52.0)	115/221 (52.0)	7/19 (36.8)	9/12 (75.0)	
Personal history of comorbidities	4/252 (1.6)	4/221 (1.8)	0/19 (0.0)	0/12 (0.0)	**0.041**
Hypertension	4/252 (1.6)	4/221 (1.8)	0/19 (0.0)	0/12 (0.0)	
Asthma	8/252 (3.2)	6/221 (2.7)	0/19 (0.0)	2/12 (16.7)	
Diabetes	3/252 (1.2)	3/221 (1.4)	0/19 (0.0)	0/12 (0.0)	
Mental illness	2/252 (0.8)	2/221 (0.9)	0/19 (0.0)	0/12 (0.0)	
Sickle cell disease	21/252 (8.3)	19/221 (8.6)	0/19 (0.0)	2/12 (16.7)	
Renal disease	1/252 (0.4)	1/221 (0.5)	0/19 (0.0)	0/12 (0.0)	
History of smoking					**<0.001**
Never smoked	248/251 (98.8)	219/220 (99.5)	19/19 (100.0)	10/12 (83.3)	
Currently smoking/Ever smoked	3/251 (1.2)	1/220 (0.5)	0/19 (0.0)	2/12 (16.7)	
Exposed to second-hand smoking					0.250
No	217/252 (86.1)	190/221 (86.0)	15/19 (78.9)	12/12 (100.0)	
Yes	35/252 (13.9)	31/221 (14.0)	4/19 (21.1)	0/12 (0.0)	
Ever consumed alcohol					**0.052**
No	171/252 (67.9)	148/221 (67.0)	17/19 (89.5)	6/12 (50.0)	
Yes	81/252 (32.1)	73/221 (33.0)	2/19 (10.5)	6/12 (50.0)	

Physical activity level					0.410
Low physical activities	73/252 (29.0)	66/221 (29.9)	3/19 (15.8)	4/12 (33.3)	
High physical activity	179/252 (71.0)	155/221 (70.1)	16/19 (84.2)	8/12 (66.7)	
Signs and symptoms exhibited					
Fever	59/252 (23.4)	48/221 (21.7)	6/19 (31.6)	5/12 (41.7)	0.190
Difficulty in breathing	32/252 (12.7)	25/221 (11.3)	3/19 (15.8)	4/12 (33.3)	0.076
Cough	63/252 (25.0)	55/221 (24.9)	6/19 (31.6)	2/12 (16.7)	0.640
Cold	68/252 (27.0)	60/221 (27.1)	6/19 (31.6)	2/12 (16.7)	0.650
Loss of taste	60/252 (23.8)	50/221 (22.6)	6/19 (31.6)	4/12 (33.3)	0.500
Loss of smell	53/252 (21.0)	45/221 (20.4)	6/19 (31.6)	2/12 (16.7)	0.480
Headache	57/252 (22.6)	49/221 (22.2)	6/19 (31.6)	2/12 (16.7)	0.570
Fatigue	53/252 (21.0)	44/221 (19.9)	6/19 (31.6)	3/12 (25.0)	0.460
Diarrhoea	7/252 (2.8)	6/221 (2.7)	1/19 (5.3)	0/12 (0.0)	0.680
Ever been vaccinated against COVID-19					0.340
Yes, full dose	188/252 (74.6)	165/221 (74.7)	12/19 (63.2)	11/12(91.7)	
Yes, a partial dose	28/252 (11.1)	25/221 (11.3)	2/19 (10.5)	1/12 (8.3)	
No	36/252 (14.3)	31/221 (14.0)	5/19 (26.3)	0/12 (0.0)	

Footnote: *High-risk workers refer to HCWs who spend more time with patients on admission, while risk workers are those who spend less time with patients

4.5 Results for Objective 2: Effect of COVID-19 on the Psychological Health of HCWs

To assess psychological health among HCWs, depression, anxiety, and stress were measured. Before this measurement, the relationship between family and work-related support and COVID-19 infection was assessed. This is presented in Table 4.5. For those who were infected with COVID-19, seeking the services of a psychologist (p<0.001), gaining support from colleagues (p<0.0001), and support from an immediate supervisor (p<0.001), significantly reduced the effects of psychological health outcomes.

Table 4.4: Family and work-related support in relation to COVID-19 infection

Characteristics	Total N=756 n/N (%)	Unexposed N=504 n/N (%)	Exposed N=252 n/N (%)	p-value
Have you been seeking the services of a psychologist				<0.001
No	700/756 (92.6)	479/504 (95.0)	221/252 (87.7)	
Yes	56/756 (7.4)	25/504 (5.0)	31/252 (12.3)	
Have family members you can rely on for advice				-
Yes	235/252 (93.3)	-	235/252 (93.3)	
No/No response	17/252 (6.7)	-	17/252 (6.7)	
Have Family members to take care of you when you are sick				0.80
Yes	681/756 (90.1)	455/504 (90.3)	226/252 (89.7)	
No/No response	75/756 (9.9)	49/504 (9.7)	26/252 (10.3)	
Support from colleagues at work				<0.001
Low support	132/756 (17.5)	53/504 (10.5)	79/252 (31.3)	
Moderate	185/756 (24.5)	120/504 (23.8)	65/252 (25.8)	
High support	439/756 (58.1)	331/504 (65.7)	108/252 (42.9)	
Support from immediate supervisor				<0.001
Low support	147/756 (19.4)	67/504 (13.3)	80/252 (31.7)	
Moderate	198/756 (26.2)	144/504 (28.6)	54/252 (21.4)	
High support	411/756 (54.4)	293/504 (58.1)	118/252 (46.8)	
Experienced discrimination due to COVID-19				-
Small extent	66/504 (13.1)	66/504 (13.1)	-	
Somewhat	88/504 (17.5)	88/504 (17.5)	-	
Large extent	350/504 (69.4)	350/504 (69.4)	-	
Work related emotional toll				0.16
Low	120/756 (15.9)	71/504 (14.1)	49/252 (19.4)	
Moderate	341/756 (45.1)	231/504 (45.8)	110/252 (43.7)	
High	295/756 (39.0)	202/504 (40.1)	93/252 (36.9)	

4.5.1 Depression

At baseline, most of the HCWs in the exposed group experienced high levels of depression IQR=28 (22 - 30). Depression was also higher in the exposed group in the midline [(IQR = 20 (14 - 28)] and end line IQR = 14 (6 - 22). Generally, depression was significantly associated with HCWs who had the COVID-19 infection. Details are shown in Figure 4.5.

Also, at baseline (0 months), HCWs who had COVID-19 infection experienced severe levels of depression (96.4%), and this was statistically significant ($x^2 = 120.84, p < 0.001$). Though the level of depression reduced at midline (month 3), most of the HCWs (85.7%) experienced severe depression in the exposed group. This further reduced to 66.3% by the 6th month, and was as well significant (x^2=75.80, p<0.001). Details are presented in Figure 4.6.

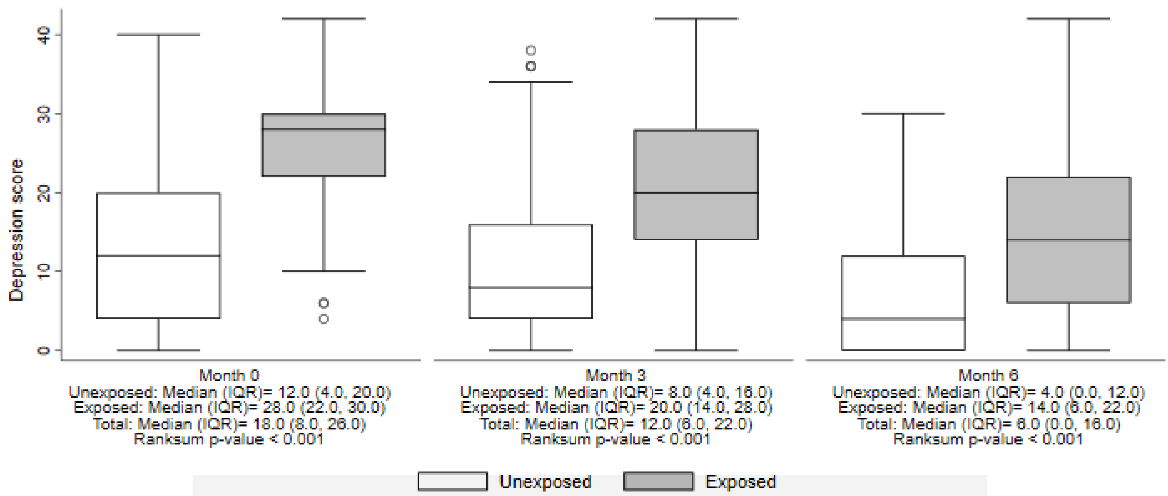

Figure 4.5: Boxplot of depression scores between the exposed and unexposed at months 0, 3 & 6.

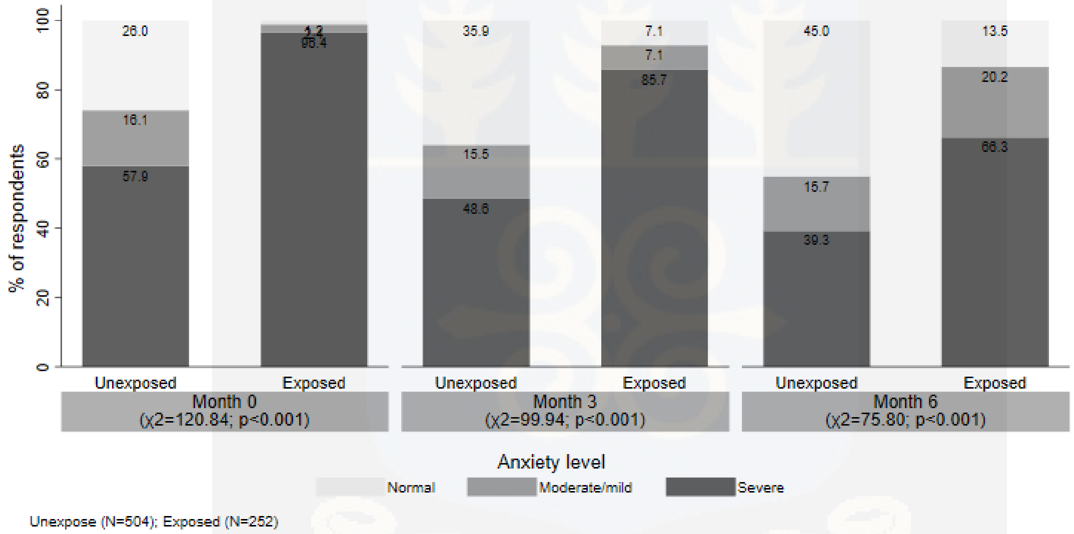

Figure 4.6: Depression Scores between the Exposed and Unexposed at Months 0, 3&6

4.5.1 Anxiety

At baseline, most of the HCWs in the exposed group experienced high levels of anxiety IQR=30 (26.0 – 34.0). The levels of anxiety were also higher in the exposed group in the midline [(IQR = 20 (18.0 – 30.0)] and end line IQR = 18 (12 - 24). Generally, the level anxiety reduced over the 6 months period but was significantly associated with HCWs who had the COVID-19 infection. Details are shown in Figure 4.7.

Also, at baseline (0 months), HCWs who had COVID-19 experienced severe anxiety (96.4%), and this was statistically significant ($x^2 = 120.84, p < 0.001$). Though the level of anxiety reduced at midline (3 months), most of the HCWs (85.7%) experienced severe anxiety in the exposed group. This was also statistically significant among those with COVID-19 infection (x^2=99.94, p<0.001). Details are presented in Figure 4.8.

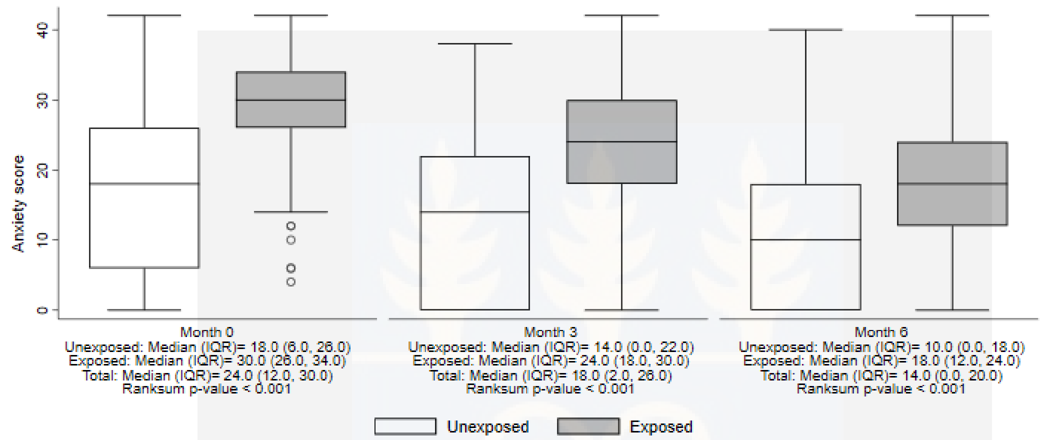

Figure 4.7: Boxplot of the anxiety scores between the exposed and unexposed at month 0, 3 & 6

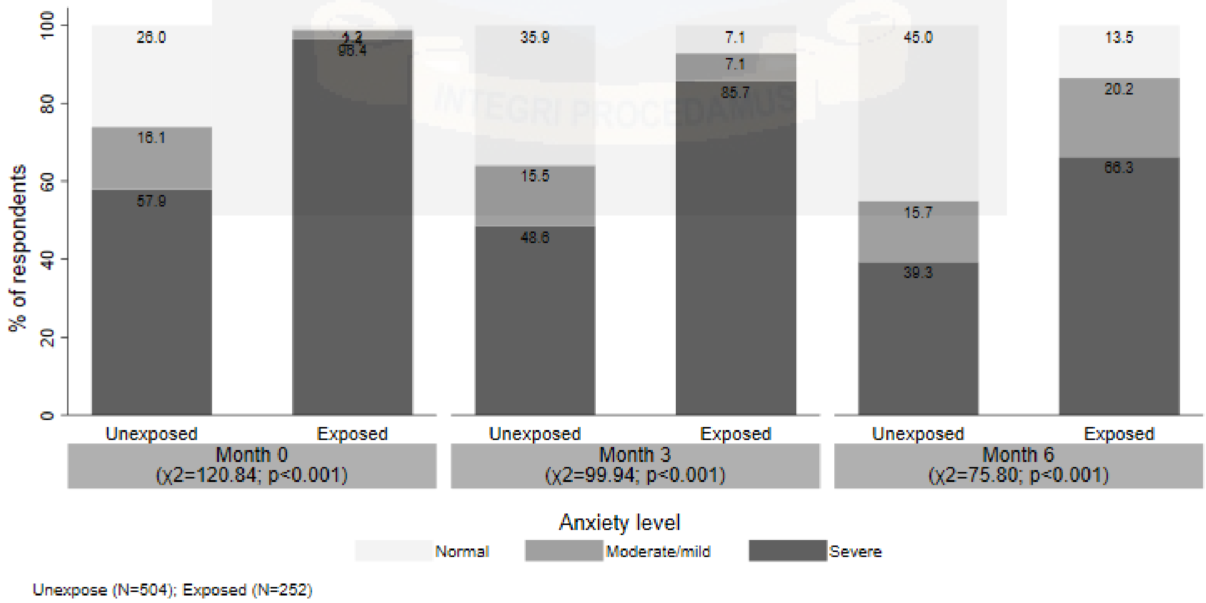

Figure 4.8: Anxiety Level between the Exposed and Unexposed at Months 0, 3 & 6

4.5.2 Stress

The levels of stress reduced over the 6months period. At baseline, most of the HCWs in the exposed group experienced high levels of stress IQR=28 (22.0 – 32.0). The levels of anxiety were also higher in the exposed group at midline [(IQR = 22 (14.0 – 30.0)] and end line IQR = 14 (8 - 20). Generally, the level of anxiety reduced over the 6 months but was significantly associated with HCWs who had the COVID-19 infection. Details are shown in Figure 4.9.

Generally, the majority of the HCWs (62.3%) experienced severe levels of Stress at baseline (0 months). This reduced to 37.3% in the 3rd month and 15.5% by the 6th month. The levels of Stress experienced, nonetheless, were statistically significant with COVID-19 infection (p<0.001). Details of the results are presented in Figure 4.10.

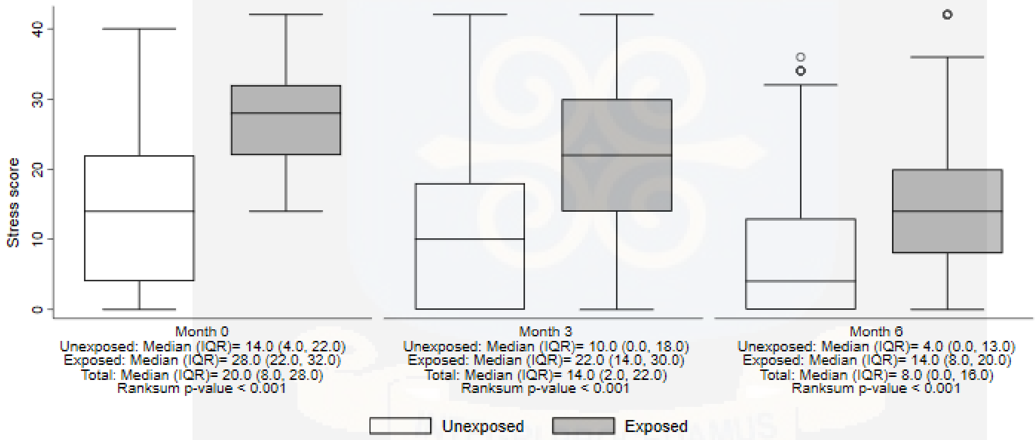

Figure 4.9: Boxplot of the anxiety scores between the exposed and unexposed at month 0, 3 & 6

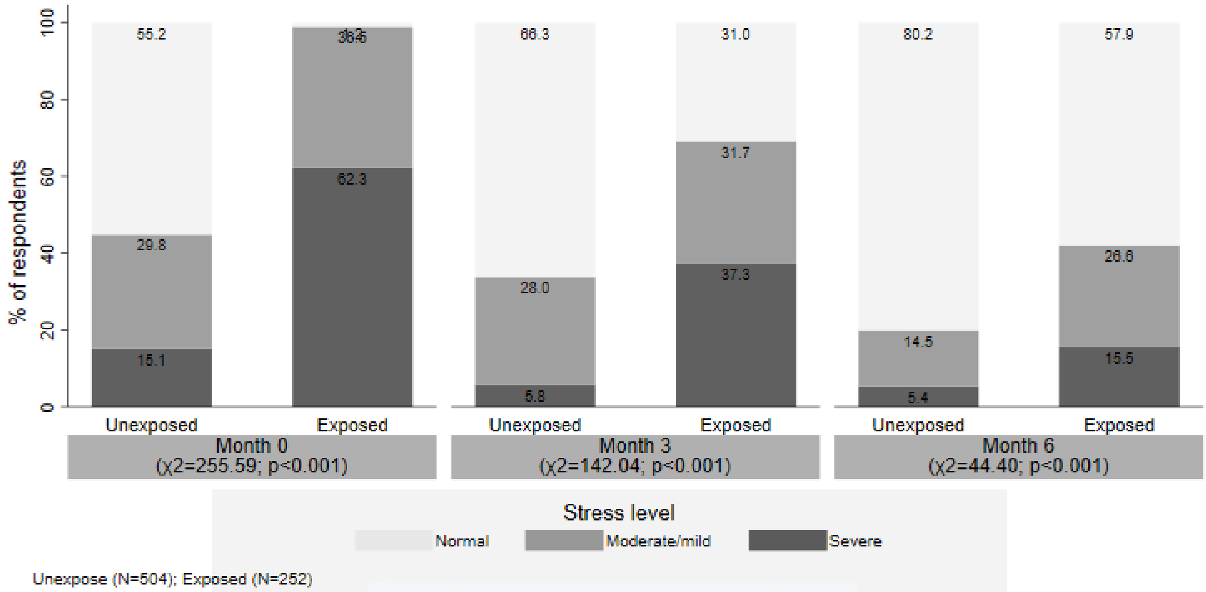

Figure 4.10: Stress Level between the Exposed and Unexposed at Month 0, 3 & 6

4.5.5 Multilevel Effect of COVID-19 Exposure and Time on Depression among HCWs

The results of the multivariate generalized ordered linear model of the effect of COVID-19 and time on depression among HCWs are presented in 4.6.

The odds of experiencing depression after being exposed to COVID-19 was 6.06 times higher compared to HCWs not exposed to COVID-19 (APOR=6.06, 95%CI= 4.38, 8.39, $p<0.001$) but the effect was reduced in the 6th month of follow-up (APOR=0.41, 95%CI=0.29, 0.58, $p<0.001$). Also, HCWs who had other part-time work were 5.55 times more likely to experience depression after being exposed to COVID-19 relative to those unexposed (APOR=5.55, 95%CI=4.18, 7.37, $p<0.001$) with reduced effect at 6 months (APOR=0.42, 95%CI=0.29, 0.59, $p<0.001$). Furthermore, HCWs who had family and personal history of chronic disease had 5.47 times higher odds of experiencing depression after being exposed to COVID-19 compared with those unexposed (APOR=5.47, 95%CI=4.06, 7.37, $p<0.001$) with a reduced effect at 6 months ($p<0.001$).

Additionally, HCWs exposed to COVID-19 who had poor lifestyle choices were 5.31 likely to be depressed compared to those unexposed (APOR=5.31, 95%CI=4.03, 7.01, $p<0.001$) but the depression reduced by 0.42 at the 6th month (APOR=0.42, 95%CI=0.29, 0.59, $p<0.001$). Also, the odds of being depressed were 5.41 times higher in HCWs exposed to COVID-19 and had no family and professional support than those unexposed (APOR=5.41, 95%CI=4.20, 6.97, $p<0.001$). Again, HCWs who exhibited COVID-19 symptoms were 4.99 times more likely to be depressed than those unexposed (APOR=4.99, 95%CI=3.84, 6.47, $p<0.001$), this effect was reduced significantly by 0.42 at 6 months ($p<0.001$).

Table 4.5: Multilevel generalized ordered linear models of the effect of COVID-19 exposure and time on depression among HCWs

Depression Variables & categories	Model 1 CPOR [95% CI]	Model 2 APOR [95% CI]	Model 3 APOR [95% CI]	Model 4 APOR [95% CI]	Model 5 APOR [95% CI]	Model 6 APOR [95% CI]	Model 7 APOR [95% CI]
Exposure status							
Unexposed	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Exposed	6.52 [4.73, 8.99] ***	6.06 [4.38, 8.39] ***	5.55 [4.18, 7.37] ***	5.47 [4.06, 7.37] ***	5.31 [4.03, 7.01] ***	5.41 [4.20, 6.97] ***	4.99 [3.84, 6.47] ***
Month							
Month 0	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Month 3	0.75 [0.63, 0.90] **	0.75 [0.63, 0.90] **	0.75 [0.62, 0.90]	0.74 [0.62, 0.89] **	0.74 [0.62, 0.89] **	0.74 [0.62, 0.88] **	0.74 [0.62, 0.88] **
Month 6	0.39 [0.34, 0.45] ***	0.39 [0.34, 0.45] ***	0.39 [0.33, 0.46] ***	0.39 [0.33, 0.45] ***	0.39 [0.33, 0.45] ***	0.39 [0.33, 0.45] ***	0.38 [0.33, 0.44] ***
Interaction Exposure*Month							
Exposed*Month 3	0.48 [0.34, 0.68] ***	0.48 [0.33, 0.69] ***	0.47 [0.33, 0.67] ***	0.48 [0.33, 0.68] ***	0.47 [0.33, 0.67] ***	0.48 [0.34, 0.68] ***	0.47 [0.33, 0.66] ***
Exposed*Month 6	0.42 [0.29, 0.59] ***	0.41 [0.29, 0.58] ***	0.42 [0.29, 0.59] ***	0.42 [0.29, 0.60] ***	0.42 [0.30, 0.59] ***	0.41 [0.29, 0.58] ***	0.42 [0.30, 0.59] ***
Marginal effects							
Unexposed @ month 0	1.00	1.00	1.00	1.00	1.00	1.00	1.00

NOTES:

Abbreviations: CPOR: crude proportional odds ratio. APOR: adjusted proportional odds ratios. CI: Confidence interval

P-value notation: p<0.005*, p<0.01**, p<0.001**

Model 1: Unadjusted odds ratio. (No covariate adjustments made)

Model 2: Includes exposure variable, interaction between exposure and month, and socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.)

Model 3: All variables from **Model 2** and work and professional related characteristics (Having other part-time job, Profession and years worked)

Model 4: All variables from **Model 3** and family and personal history of comorbidities (Family history of comorbidities, family history of hypertension, family history of diabetes, have comorbidities, have asthma, have diabetes)

Model 5: All variables from **Model 4** and lifestyle characteristics (History of smoking, having friends and family that smoke, exposure to secondhand smoking, consumes alcohol, engagement in vigorous physical activities at workplace, engagement in moderate physical activities at workplace, walks or cycles for at least 10 minutes daily, engagement in vigorous sports activities, engagement in moderate-intensity sports)

Model 6: All variables from **Model 5** and family and workplace support (Consulting a psychologist, having family members to take care of respondent when sick, support level from a colleague at workplace, support level from immediate supervisor at the workplace, level of work-related emotional toll).

Model 7: All variables from **Model 6** and covid-19 related characteristics and symptoms (Number of COVID-19 tests done before baseline, reason for conducting COVID-19 test, Time to receive COVID-19 test results, COVID-19 vaccination status, and experience of fever, difficulty in breathing, fatigue, and diarrhea before conducting COVID-19 test)

4.5.7 Multilevel Association of COVID-19 Exposure and Time on Anxiety among HCWs

The results on the multilevel association between the effect of COVID-19 exposure and time on anxiety among HCWs are presented in Table 4.7.

Compared to HCWs not exposed to COVID-19, those exposed were 4.16 times more likely of experiencing anxiety (APOR=4.16, 95%CI= 2.42, 7.15, p<0.001) but the effect is significantly reduced by 0.55 in the 6th month of follow-up (p<0.005). Also, HCWs who have other part-time work were 3.57 more likely to experience anxiety after being exposed to COVID-19 relative to those unexposed (APOR=3.57, 95%CI=2.23, 5.72, p<0.001) with a 0.57 reduced anxiety effect at 6 months (p<0.005). Furthermore, HCWs who had family and personal history of chronic disease had 3.59 times higher odds of being anxious after being exposed to COVID-19 compared with those unexposed (APOR=3.59, 95%CI=2.23, 5.77, p<0.001) with a reduced effect at 6 months (p<0.001).

Additionally, HCWs exposed to COVID-19 who had poor lifestyle choices were 3.41 times more likely to be anxious compared to those unexposed (APOR=3.41, 95%CI=2.20, 5.28, p<0.001) but the depression reduced by 0.42 at the 6th month (p<0.005). Also, there was 3.45 increased odds that HCWs exposed to COVID-19 and had no family and professional support experience anxiety than those unexposed (APOR=3.45, 95%CI=2.32, 5.12, p<0.001). Again, HCWs who exhibited COVID-19 symptoms were 3.57 times more likely to be anxious than those unexposed (APOR=3.57, 95%CI=3.84, 6.47, p<0.001), this effect was reduced significantly by 0.63 at 3 months (p<0.005).

Table 4.6: Multilevel generalized ordered linear models of the effect of COVID-19 exposure and time on anxiety among HCWs

Anxiety	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Variables & categories	**CPOR [95% CI]**	**APOR [95% CI]**	**APOR [95% CI]**	**APOR [95% CI]**	**APOR [95% CI]**	**APOR [95% CI]**	**APOR [95% CI]**
Exposure status							
Unexposed	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Exposed	4.51 [2.57, 7.90] ***	4.16 [2.42, 7.15] ***	3.57 [2.23, 5.72] ***	3.59 [2.23, 5.77] ***	3.41 [2.20, 5.28] ***	3.45 [2.32, 5.12] ***	3.57 [2.43, 5.24] ***
Month							
Month 0	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Month 3	0.75 [0.57, 0.99] *	0.75 [0.58, 0.98] *	0.76 [0.59, 0.97] *	0.76 [0.59, 0.97] *	0.75 [0.58, 0.96] *	0.74 [0.58, 0.95] *	0.75 [0.59, 0.96] *
Month 6	0.57 [0.47, 0.69] ***	0.57 [0.47, 0.69] ***	0.57 [0.46, 0.69] ***	0.57 [0.46, 0.69] ***	0.56 [0.46, 0.68] ***	0.56 [0.46, 0.67] ***	0.55 [0.46, 0.66] ***
Interaction Exposure*Month							
Exposed*Month 3	0.68 [0.44, 1.07]	0.70 [0.46, 1.07]	0.69 [0.47, 1.03]	0.69 [0.47, 1.02]	0.69 [0.47, 0.99] *	0.69 [0.48, 1.00]	0.63 [0.43, 0.92] *
Exposed*Month 6	0.54 [0.32, 0.90] *	0.55 [0.33, 0.90] *	0.57 [0.36, 0.91] *	0.57 [0.35, 0.91] *	0.57 [0.36, 0.90] *	0.57 [0.37, 0.89] *	0.54 [0.35, 0.85] **
Marginal effects							
Unexposed @ month 0	1.00	1.00	1.00	1.00	1.00	1.00	1.00

NOTES:
Abbreviations: CPOR: crude proportional odds ratio. APOR: adjusted proportional odds ratios. CI: Confidence interval
P-value notation: p<0.005*, p<0.01**, p<0.001**
Unadjusted odds ratio. (No covariate adjustments made)
Model 2: Includes exposure variable, interaction between exposure and month and socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.)
Model 3: All variables from **Model 2** and work and professional-related characteristics (Having other part-time job, Profession and years worked)
Model 4: All variables from **Model 3** and family and personal history of comorbidities (Family history of comorbidities, family history of hypertension, family history of diabetes, have comorbidities, have asthma, have diabetes)
Model 5: All variables from **Model 4** and lifestyle characteristics (History of smoking, having friends and family that smokes, exposure to second hand smoking, consumes alcohol, engagement in vigorous physical activities at workplace, engagement in moderate physical activities at workplace, walks or cycles for at least 10 minutes daily, engagement in vigorous sports activities, engagement in moderate-intensity sports)
Model 6: All variables from **Model 5** and family and workplace support (Consulting a psychologist, have family members to take care of respondent when sick, support level from a colleague at workplace, support level from an immediate supervisor at the workplace, level of work-related emotional toll).
Model 7: All variables from **Model 6** and COVID-19-related characteristics and symptoms (Number of COVID-19 test done before baseline, reason for conducting COVID-19 test, Time to receive COVID-19 test results, COVID-19 vaccination status, and experience of fever, difficulty in breathing, fatigue, and diarrhoea before conducting COVID-19 test)

4.5.9 Multilevel Association between COVID-19 Exposure and Time on Stress

The results of the multilevel generalized linear models of the effect of COVID-19 exposure and time on stress among HCWs are presented in 4.8.

HCWs exposed to COVID-19 are 6.78 times more likely to be stressed (APOR=6.78, 95%CI= 5.40, 8.51, p<0.001) relative to those unexposed but the effect is significantly reduced by 0.35 in the 6^{th} month of follow-up (p<0.001). Similarly, HCWs who have other part-time work were 6.33 more likely to be stressed after being exposed to COVID-19 compared to those unexposed (APOR=6.33, 95%CI=4.94, 8.12, p<0.001) with a 0.34 reduced stress effect at 6 months (p<0.001). Moreover, HCWs who had family and personal history of chronic disease had 6.23 times higher odds of being stressed after being exposed to COVID-19 compared with those unexposed (APOR=6.23, 95%CI=4.88, 7.94, p<0.001) with a reduced effect of 0.34 at 6 months (p<0.001).

Furthermore, HCWs exposed to COVID-19 and had poor lifestyle choices were 6.03 more likely to be stressed compared to those unexposed (APOR=6.03, 95%CI=4.64, 7.84, p<0.001) but the stress levels reduced by 0.34 at the6^{th} month (p<0.001). Likewise, there was 6.10 increased odds that HCWs exposed to COVID-19 and had no family and professional support experience stress than those unexposed (APOR=6.10, 95%CI=4.85, 7.67, p<0.001). Again, HCWs who exhibited COVID-19 symptoms were 6.03 times more likely to be stressed than those unexposed (APOR=6.03, 95%CI=4.55, 7.98, p<0.001), this effect was reduced significantly by 0.34 at 6 months (p<0.001).

Table 4.7: Multilevel Association between COVID-19 Exposure and Time on Stress

Stress	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Variables & categories	**CPOR [95% CI]**	**APOR [95% CI]**	**APOR [95% CI]**	**APOR [95% CI]**	**APOR [95% CI]**	**APOR [95% CI]**	**APOR [95% CI]**
Exposure status							
Unexposed	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Exposed	7.31 [5.84, 9.16] ***	6.78 [5.40, 8.51] ***	6.33 [4.94, 8.12] ***	6.23 [4.88, 7.94] ***	6.03 [4.64, 7.84] ***	6.10 [4.85, 7.67] ***	6.03 [4.55, 7.98] ***
Month							
Month 0	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Month 3	0.66 [0.53, 0.81] ***	0.66 [0.54, 0.81] ***	0.66 [0.54, 0.81] ***	0.66 [0.54, 0.81] ***	0.66 [0.54, 0.80] ***	0.65 [0.54, 0.79] ***	0.66 [0.54, 0.80] ***
Month 6	0.36 [0.27, 0.47] ***	0.36 [0.27, 0.48] ***	0.36 [0.27, 0.48] ***	0.36 [0.27, 0.48] ***	0.36 [0.27, 0.48] ***	0.36 [0.27, 0.48] ***	0.36 [0.27, 0.48] ***
Interaction Exposure*Month							
Exposed*Month 3	0.48 [0.32, 0.72] ***	0.48 [0.33, 0.71] ***	0.47 [0.32, 0.69] ***	0.47 [0.32, 0.69] ***	0.46 [0.32, 0.68] ***	0.47 [0.32, 0.67] ***	0.46 [0.32, 0.67] ***
Exposed*Month 6	0.35 [0.21, 0.59] ***	0.35 [0.20, 0.59] ***	0.34 [0.20, 0.58] ***	0.34 [0.20, 0.58] ***	0.34 [0.20, 0.59] ***	0.34 [0.19, 0.59] ***	0.34 [0.19, 0.60] ***
Marginal effects							
Unexposed @ month 0	1.00	1.00	1.00	1.00	1.00	1.00	1.00

NOTES:
Abbreviations: CPOR: crude proportional odds ratio. APOR: adjusted proportional odds ratios. CI: Confidence interval
P-value notation: p<0.005*, p<0.01**, p<0.001**
Unadjusted odds ratio. (No covariate adjustments made)
Model 2: Includes exposure variable, interaction between exposure and month and socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.)
Model 3: All variables from **Model 2** and work and professional related characteristics (Having other part-time job, Profession and years worked)
Model 4: All variables from **Model 3** and family and personal history of comorbidities (Family history of comorbidities, family history of hypertension, family history of diabetes, have comorbidities, have asthma, have diabetes)
Model 5: All variables from **Model 4** and lifestyle characteristics (History of smoking, have friends and family that smokes, exposure to second-hand smoking, consumes alcohol, engagement in vigorous physical activities at workplace, engagement in moderate physical activities at workplace, walks or cycles for at least 10 minutes daily, engagement in vigorous sports activities, engagement in moderate-intensity sports)
Model 6: All variables from **Model 5** and family and workplace support (Consulting a psychologist, have family members to take care of respondent when sick, support level from colleagues at workplace, support level from an immediate supervisor at the workplace, level of work-related emotional toll).
Model 7: All variables from **Model 6** and covid-19 related characteristics and symptoms (Number of COVID-19 tests done before baseline, reason for conducting COVID-19 test, Time to receive COVID-19 test results, COVID-19 vaccination status, and experience of fever, difficulty in breathing, fatigue, and diarrhoea before conducting COVID-19 test)

4.6 Effect of COVID-19 on Blood Pressure among Healthcare Workers

The HCWs in the exposed group experienced normal blood pressure across the data collection points (75.8% at month 0, 72.6% at month 3, and 64.3% at month 6). It was, however, statistically significant among those in the exposed group at months 0 and 6 ($x^2 = 25.49, p < 0.001, x^2 = 78.85, \mathrm{p} < 0.001$). Details of the results are presented in Figure 4.11.

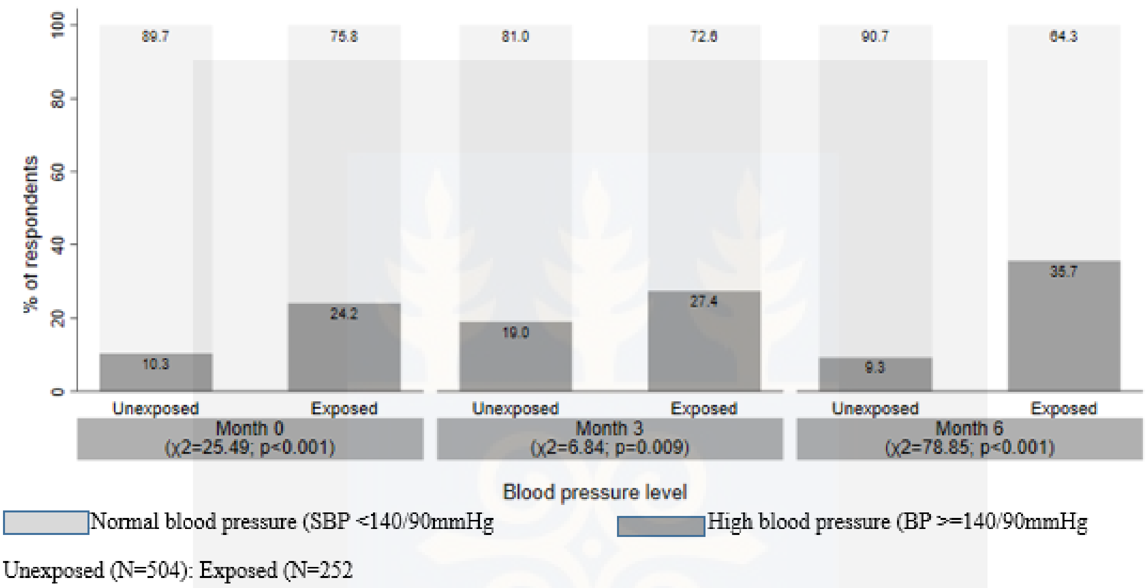

Figure 4.11: Blood pressure level between the exposed and unexposed at month 0, 3 & 6

4.6.2 Multilevel Association between COVID-19 Exposure and Time and BP

Table 4.9 presents the results of the multilevel association between COVID-19 exposure and time and BP among HCWs.

HCWs exposed to COVID-19 are 2.39 times more likely to have high BPs (APOR=2.39, 95%CI= 1.55, 3.68, p<0.001) relative to those unexposed but the effect is significantly reduced by 0.64 in the 3rd month of follow-up (p<0.005). Similarly, HCWs who have other part-time work were 2.33 more likely to have high BP after being exposed to COVID-19 compared to those unexposed (APOR=2.33, 95%CI=1.56, 3.47, p<0.001) with a 0.64 reduced BP effect at

3 months ($p<0.001$). Moreover, HCWs who had family and personal history of chronic disease had 2.31 times higher odds of experiencing high BP after being exposed to COVID-19 compared with those unexposed (APOR=2.31, 95%CI=1.55, 3.44, $p<0.001$) with a reduced effect of 0.65 at 3 months ($p<0.001$).

Furthermore, HCWs exposed to COVID-19 and who had poor lifestyle choices were 2.46 more likely to experience high BP compared to those unexposed (APOR=2.46, 95%CI=1.62, 3.73, $p<0.001$) but the BP levels reduced significantly by 0.64 at 3rd month ($p<0.001$) and increased by 1.96 at the 6th month ($p<0.001$). Likewise, there is a 2.41 increased odds that HCWs exposed to COVID-19 and had no family and professional support experience high BP than those unexposed (APOR=2.41, 95%CI=1.59, 3.65, $p<0.001$). Again, HCWs who exhibited COVID-19 symptoms were 2.34 times more likely to have high BP than those unexposed (APOR=2.34, 95%CI=1.57, 3.50, $p<0.001$). This effect increased significantly by 1.95 at 6 months ($p<0.005$).

Table 4.8: Multilevel Generalized Linear Models of the Effect of COVID-19 Exposure and Time on High Blood Pressure among HCWs

High blood pressure	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Variables & categories	**COR [95% CI]**	**AOR [95% CI]**	**AOR [95% CI]**	**AOR [95% CI]**	**AOR [95% CI]**	**AOR [95% CI]**	**AOR [95% CI]**
Exposure status							
Unexposed	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Exposed	2.75 [1.77, 4.26] ***	2.39 [1.55, 3.68] ***	2.33 [1.56, 3.47] ***	2.31 [1.55, 3.44] ***	2.46 [1.62, 3.73] ***	2.41 [1.59, 3.65] ***	2.34 [1.57, 3.50] ***
Month							
Month 0	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Month 3	2.01 [1.47, 2.75] ***	2.00 [1.45, 2.75] ***	2.00 [1.45, 2.75] ***	1.99 [1.45, 2.74] ***	1.99 [1.45, 2.72] ***	1.99 [1.45, 2.72] ***	1.99 [1.45, 2.72] ***
Month 6	0.90 [0.61, 1.32]	0.89 [0.60, 1.32]	0.89 [0.60, 1.32]	0.89 [0.60, 1.32]	0.89 [0.60, 1.32]	0.89 [0.60, 1.32]	0.89 [0.60, 1.33]
Interaction Exposure*Month							
Exposed*Month 3	0.64 [0.43, 0.95] *	0.64 [0.43, 0.96] *	0.64 [0.43, 0.96] *	0.65 [0.43, 0.98] *	0.64 [0.42, 0.97] *	0.63 [0.41, 0.97] *	0.65 [0.42, 1.00]
Exposed*Month 6	1.94 [1.17, 3.21] *	1.95 [1.17, 3.26] *	1.95 [1.16, 3.29] *	1.96 [1.16, 3.31] *	1.95 [1.15, 3.31] *	1.96 [1.16, 3.31] *	1.95 [1.15, 3.30] *
Marginal effects							
Unexposed @ month 0	1.00	1.00	1.00	1.00	1.00	1.00	1.00

NOTES:
Abbreviations: COR: crude odds ratio. AOR: adjusted odds ratios. CI: Confidence interval
P-value notation: p<0.005*, p<0.01**, p<0.001***
Unadjusted odds ratio. (No covariate adjustments made)
Model 2: Includes exposure variable, the interaction between exposure and month and socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.)
Model 3: All variables from **Model 2** and work and professional related characteristics (Having another part-time job, Profession and years worked)
Model 4: All variables from **Model 3** and family and personal history of comorbidities (Family history of comorbidities; family history of hypertension, family history of diabetes, personal history of comorbidities; have asthma, have diabetes)
Model 5: All variables from **Model 4** and lifestyle characteristics (History of smoking, having friends and family that smoke, exposure to second-hand smoking, consuming alcohol, engagement in vigorous physical activities at workplace, engagement in moderate physical activities at workplace, walks or cycles for at least 10 minutes daily, engagement in vigorous sports activities, engagement in moderate-intensity sports)
Model 6: All variables from **Model 5** and family and workplace support (Consulting a psychologist, having family members to take care of respondent when sick, support level from a colleague at workplace, support level from an immediate supervisor at workplace, level of work-related emotional toll).
Model 7: All variables from **Model 6** and COVID-19-related characteristics and symptoms (Number of COVID-19 tests done before baseline, reason for conducting COVID-19 test, Time to receive COVID-19 test results, COVID-19 vaccination status, and experience of fever, difficulty in breathing, fatigue, and diarrhoea before conducting COVID-19 test)

4.7 Effect of COVID-19 on the Lung Function of Healthcare Workers

The majority of the HCWs in the exposed group (75.4%) reported normal lung function at month 0 (75.4%), month 3 (79.7%) and month 6 (71.6%). There was however, a statistically significant relationship between the effect of COVID-19 and lung function among HCW at months 0 and 6 among those who had the COVID-19 infection ($x^2 = 38.72, p < 0.001, x^2$=76.46, p<0.001). Details of the results are presented in Figure 4.12.

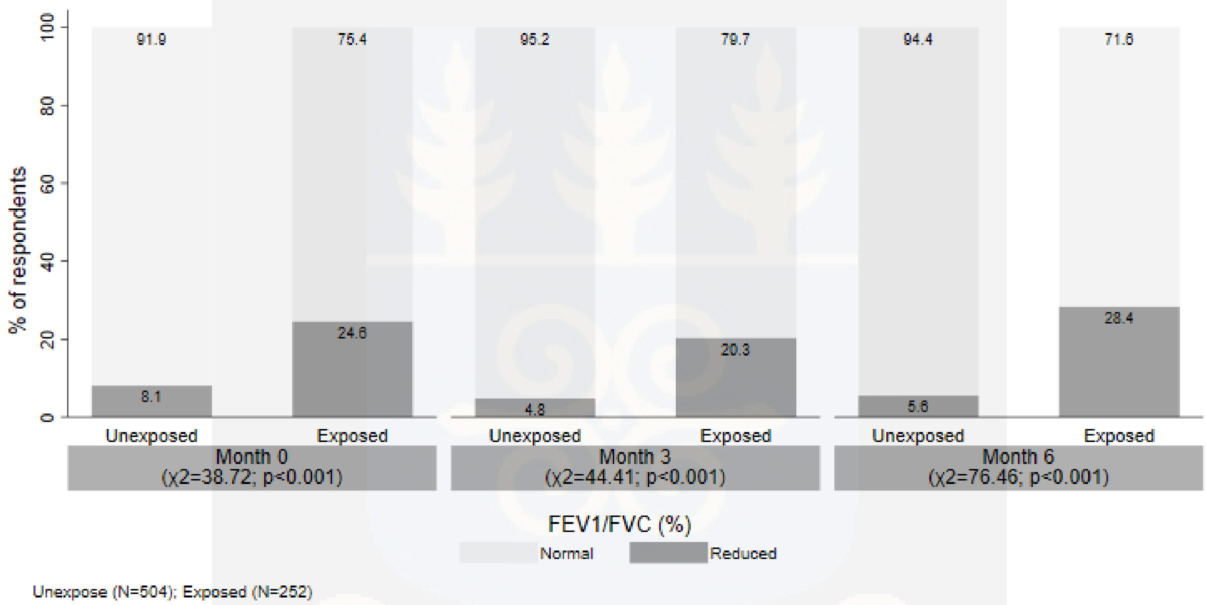

Figure 4.12: Lung function level between the exposed and unexposed at month 0, 3 & 6

4.7.2 Multilevel Association between COVID-19 Exposure and Time on Lung Function among HCWs

The result presented in Table 4.10 is the multilevel association between COVID-19 exposure and time on lung function among HCWs

For HCWs exposed to COVID-19, there is a 3.20 increased odds of experiencing reduced lung function (APOR=3.20, 95%CI= 1.99, 5.15, p<0.001) relative to those unexposed. Similarly, HCWs who have other part-time work were 3.11 more likely to have reduced lung function after being exposed to COVID-19 compared to those unexposed (APOR=3.11, 95%CI=1.56, 3.47, p<0.001). Moreover, HCWs who had family and personal history of comorbidities had 3.08 times higher odds of experiencing reduced lung function after being exposed to COVID-19 compared with those unexposed (APOR=3.08, 95%CI=1.88, 5.04, p<0.001).

Furthermore, HCWs exposed to COVID-19 and who had poor lifestyle choices were 2.96 time more likely to experience reduced lung function compared to those unexposed (APOR=2.96, 95%CI=1.75, 5.03, p<0.001). Likewise, there is a 2.41 increased odds that HCWs exposed to COVID-19 and had no family and professional support experience reduced lung function than those unexposed (APOR=2.41, 95%CI=1.59, 3.65, p<0.001). Again, HCWs who exhibited COVID-19 symptoms were 2.34 times more likely to have reduced lung function than those unexposed (APOR=3.13, 95%CI=1.81, 5.41, p<0.001).

Table 4.9: Multilevel Generalized Ordered Linear Models of the Effect of COVID-19 Exposure and Time on Reduced Lung Function among HCWs

Reduced lung function	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Variables & categories	**COR [95% CI]**	**AOR [95% CI]**	**AOR [95% CI]**	**AOR [95% CI]**	**AOR [95% CI]**	**AOR [95% CI]**	**AOR [95% CI]**
Exposure status							
Unexposed	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Exposed	3.40 [2.10, 5.52] ***	3.20 [1.99, 5.15] ***	3.11 [1.88, 5.15] ***	3.08 [1.88, 5.04] ***	2.96 [1.75, 5.03] ***	3.10 [1.79, 5.36] ***	3.13 [1.81, 5.41] ***
Month							
Month 0	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Month 3	0.57 [0.34, 0.95] *	0.57 [0.35, 0.95] *	0.57 [0.35, 0.95] *	0.57 [0.35, 0.95] *	0.57 [0.35, 0.96] *	0.57 [0.34, 0.96] *	0.57 [0.34, 0.96] *
Month 6	0.67 [0.35, 1.28]	0.67 [0.35, 1.28]	0.67 [0.35, 1.28]	0.67 [0.35, 1.28]	0.67 [0.35, 1.28]	0.67 [0.35, 1.28]	0.67 [0.35, 1.28]
Interaction Exposure*Month							
Exposed*Month 3	1.39 [0.82, 2.36]	1.41 [0.84, 2.37]	1.40 [0.83, 2.37]	1.40 [0.82, 2.39]	1.32 [0.75, 2.33]	1.32 [0.75, 2.33]	1.31 [0.74, 2.31]
Exposed*Month 6	1.78 [0.72, 4.41]	1.79 [0.72, 4.43]	1.78 [0.72, 4.40]	1.77 [0.72, 4.38]	1.70 [0.68, 4.27]	1.70 [0.67, 4.31]	1.74 [0.68, 4.43]
Marginal effects							
Unexposed @ month 0	1.00	1.00	1.00	1.00	1.00	1.00	1.00

NOTES:
Abbreviations: COR: crude odds ratio. AOR: adjusted odds ratios. CI: Confidence interval
P-value notation: p<0.005*, p<0.01**, p<0.001***
Unadjusted odds ratio. (No covariate adjustments made)
Model 2: Includes exposure variable, interaction between exposure and month and socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.)
Model 3: All variables from **Model 2** and work and professional related characteristics (Having another part-time job, Profession and years worked)
Model 4: All variables from **Model 3** and family and personal history of comorbidities (Family history of comorbidities; family history of hypertension, family history of diabetes, personal history of comorbidities; have asthma, have diabetes)
Model 5: All variables from **Model 4** and lifestyle characteristics (History of smoking, having friends and family that smoke, exposure to second-hand smoking, consuming alcohol, engagement in vigorous physical activities at workplace, engagement in moderate physical activities at workplace, walks or cycles for at least 10 minutes daily, engagement in vigorous sports activities, engagement in moderate-intensity sports)
Model 6: All variables from **Model 5** and family and workplace support (Consulting a psychologist, having family members to take care of respondent when sick, support level from a colleague at workplace, support level from an immediate supervisor at workplace, level of work-related emotional toll).
Model 7: All variables from **Model 6** and COVID-19-related characteristics and symptoms (Number of COVID-19 tests done before baseline, reason for conducting COVID-19 test, Time to receive COVID-19 test results, COVID-19 vaccination status, and experience of fever, difficulty in breathing, fatigue, and diarrhoea before conducting COVID-19 test)

4.7.3 Interacting Effect of Lifestyle and Physical Activities in the Relation between COVID-19 and Psychological Health

The odds of being depressed if exposed to second-hand smoking is 1.47 times higher among HCWs in the exposed group compared to those not exposed to second-hand smoking (APOR=1.47; 95%CI=1.09, 1.98). Also, the odds of depression among those who do daily walking/cycling were 0.77 times lower among HCWs in the exposed group compared to the unexposed group (CPOR=0.77, 95%CI=0.61, 0.97). Vigorous-intensity sports had 0.74 times increased odds of reducing depression among HCWs in the exposed group compared with others (CPOR=0.74, 95%CI=0.61, 0.89). The results on lifestyle in relation between COVID-19 and depression are presented in Table 4.11.

Also, the odds of experiencing anxiety after contracting COVID-19 were 64% higher among HCWs who were exposed to second smoking compared to those who were not exposed to second-hand smoking (APOR=1.36, 95%CI= 1.08, 1.70). Furthermore, HCWs who consumed alcohol had a 17.0% reduction in the odds of experiencing severe anxiety after contracting COVID-19 compared to those who did not consume alcohol (APOR=0.83, 95%CI=0.70, 0.98). The results on lifestyle in the relation between COVID-19 and anxiety are presented in Table 4.12.

In the adjusted proportionate model, no statistical significance was observed between lifestyle characteristics concerning COVID-19 and stress levels among HCWs in the exposed group. However, in the crude proportionate model, the odds of stress among those who do daily walking/cycling were 0.73 times lower among HCWs in the exposed group compared to the unexposed group (CPOR=0.73, 95%CI=0.60, 0.88). Also, the odds of reduced stress among those involved in vigorous-intensity sports were 0.86 times among HCWs in the exposed group compared with others (CPOR=0.86, 95%CI=0.75, 0.98). The result is presented in Table 4.13.

Table 4.10: Multilevel Generalized Ordered Linear Models of the Effect of Lifestyle Characteristics on Depression among HCWs

Depression level	Unadjusted model		Adjusted model	
Variables & categories	**CPOR [95% CI]**	**P-value**	**APOR [95% CI]**	**P-value**
History of smoking				
Never smoked	1.00 [reference]		1.00 [reference]	
Currently /Ever smoked	0.97 [0.62, 1.53]	0.902	1.12 [0.77, 1.62]	0.550
Have friends or family that smokes				
No	1.00 [reference]		1.00 [reference]	
Yes	1.18 [0.86, 1.62]	0.301	0.89 [0.60, 1.32]	0.557
Exposed to second-hand smoking				
No	1.00 [reference]		1.00 [reference]	
Yes	1.25 [1.01, 1.55]	**0.039**	1.47 [1.09, 1.98]	**0.011**
Consumes alcohol				
No	1.00 [reference]		1.00 [reference]	
Yes	0.92 [0.74, 1.14]	0.438	0.95 [0.80, 1.13]	0.560
Work involves vigorous-intensity activities.				
No	1.00 [reference]		1.00 [reference]	
Yes	0.89 [0.77, 1.02]	0.099	0.92 [0.80, 1.06]	0.236
Work involves moderate-intensity activities.				
No	1.00 [reference]		1.00 [reference]	
Yes	0.92 [0.74, 1.15]	0.477	0.99 [0.87, 1.14]	0.918
Walk/cycle daily for at least 10 minutes per day				
No	1.00 [reference]		1.00 [reference]	
Yes	0.77 [0.61, 0.97]	**0.028**	0.98 [0.81, 1.18]	0.842
Does vigorous-intensity sports				
No	1.00 [reference]		1.00 [reference]	
Yes	0.74 [0.61, 0.89]	**0.001**	0.90 [0.79, 1.04]	0.152
Does moderate-intensity sports				
No	1.00 [reference]		1.00 [reference]	
Yes	0.78 [0.64, 0.95]	**0.011**	1.02 [0.87, 1.19]	0.841

NOTES:
Abbreviations: CPOR: crude proportional odds ratio. APOR: adjusted proportional odds ratios. CI: Confidence interval
Variables controlled in the Adjusted model:
Includes exposure the interaction between exposure to COVID-19 and (month),
Socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.),
Lifestyle characteristics (History of smoking, exposure to second-hand smoking, consuming alcohol, engagement in vigorous physical activities at the workplace, engagement in moderate physical activities at the workplace, walks or cycles for at least 10 minutes daily, engagement in vigorous sports activities, engagement in moderate-intensity sports)

Table 4.11: Multilevel Generalized Ordered Linear Models of the Effect of Lifestyle Characteristics on Anxiety among HCWs

Anxiety level	Unadjusted model		Adjusted model	
Variables & categories	**CPOR [95% CI]**	**P-value**	**APOR [95% CI]**	**P-value**
History of smoking				
Never smoked	1.00 [reference]		1.00 [reference]	
Currently /Ever smoked	0.92 [0.50, 1.69]	0.779	0.90 [0.64, 1.26]	0.531
Have friends or family that smokes				
No	1.00 [reference]		1.00 [reference]	
Yes	1.22 [0.86, 1.73]	0.272	1.11 [0.82, 1.51]	0.484
Exposed to second-hand smoking				
No	1.00 [reference]		1.00 [reference]	
Yes	1.24 [1.04, 1.49]	0.017	1.36 [1.08, 1.70]	**0.008**
Consumes alcohol				
No	1.00 [reference]		1.00 [reference]	
Yes	0.80 [0.64, 1.00]	0.049	0.83 [0.70, 0.98]	**0.025**
Work involves vigorous-intensity activities.				
No	1.00 [reference]		1.00 [reference]	
Yes	0.92 [0.80, 1.06]	0.257	0.97 [0.85, 1.09]	0.584
Work involves moderate-intensity activities.				
No	1.00 [reference]		1.00 [reference]	
Yes	0.94 [0.76, 1.15]	0.522	0.96 [0.87, 1.06]	0.424
Walk/cycle daily for at least 10 minutes per day				
No	1.00 [reference]		1.00 [reference]	
Yes	0.77 [0.64, 0.93]	**0.007**	0.96 [0.84, 1.10]	0.557
Does vigorous-intensity sports				
No	1.00 [reference]		1.00 [reference]	
Yes	0.78 [0.66, 0.93]	**0.005**	0.99 [0.89, 1.11]	0.898
Does moderate-intensity sports				
No	1.00 [reference]		1.00 [reference]	
Yes	0.73 [0.61, 0.88]	**0.001**	0.92 [0.80, 1.05]	0.215

NOTES:
Abbreviations: CPOR: crude proportional odds ratio. APOR: adjusted proportional odds ratios. CI: Confidence interval
Variables controlled in the Adjusted model:
Includes the interaction between exposure to COVID-19 and (month),
Socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.),
Lifestyle characteristics (History of smoking, exposure to second-hand smoking, consuming alcohol, engagement in vigorous physical activities at the workplace, engagement in moderate physical activities at the workplace, walks or cycles for at least 10 minutes daily, engagement in vigorous sports activities, engagement in moderate-intensity sports).

Table 4.12: Multilevel Generalized Ordered Linear Models of the Effect of Lifestyle Characteristics on Stress among HCWs

Stress level	Unadjusted model		Adjusted model	
Variables & categories	**CPOR [95% CI]**	**P-value**	**APOR [95% CI]**	**P-value**
History of smoking				
Never smoked	1.00 [reference]		1.00 [reference]	
Currently /Ever smoked	0.83 [0.48, 1.45]	0.513	1.00 [0.62, 1.62]	0.993
Have friends or family that smokes				
No	1.00 [reference]		1.00 [reference]	
Yes	1.20 [0.79, 1.84]	0.388	1.06 [0.75, 1.51]	0.728
Exposed to second-hand smoking				
No	1.00 [reference]		1.00 [reference]	
Yes	1.21 [0.95, 1.53]	0.123	1.17 [0.78, 1.74]	0.448
Consumes alcohol				
No	1.00 [reference]		1.00 [reference]	
Yes	0.95 [0.79, 1.15]	0.630	1.01 [0.89, 1.13]	0.931
Work involves vigorous-intensity activities.				
No	1.00 [reference]		1.00 [reference]	
Yes	0.90 [0.77, 1.06]	0.198	0.89 [0.76, 1.04]	0.139
Work involves moderate-intensity activities.				
No	1.00 [reference]		1.00 [reference]	
Yes	0.93 [0.75, 1.16]	0.524	1.11 [0.95, 1.30]	0.180
Walk/cycle daily for at least 10 minutes per day				
No	1.00 [reference]		1.00 [reference]	
Yes	0.73 [0.60, 0.88]	**0.001**	0.86 [0.70, 1.06]	0.163
Does vigorous-intensity sports				
No	1.00 [reference]		1.00 [reference]	
Yes	0.86 [0.75, 0.98]	**0.029**	1.10 [0.92, 1.33]	0.299
Does moderate-intensity sports				
No	1.00 [reference]		1.00 [reference]	
Yes	0.78 [0.62, 0.99]	**0.042**	0.92 [0.76, 1.13]	0.431

NOTES:
Abbreviations: CPOR: crude proportional odds ratio. APOR: adjusted proportional odds ratios. CI: Confidence interval
Variables controlled in the Adjusted model:
Includes the interaction between exposure to COVID-19 and (month),
Socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.),
Lifestyle characteristics (History of smoking, exposure to second-hand smoking, consuming alcohol, engagement in vigorous physical activities at the workplace, engagement in moderate physical activities at the workplace, walks or cycles for at least 10 minutes daily, engagement in vigorous sports activities, engagement in moderate-intensity sports.

4.8 Interacting Effect of Lifestyle/Physical Activities in the Relation between COVID-19 and BP

No statistical significance was observed between lifestyle characteristics, COVID-19, and high BP among HCWs in the exposed group. The results are presented in Table 4.14.

Table 4.13: Multilevel Generalized Logistic Regression Models of the Effect of Lifestyle Characteristics on High Blood Pressure among HCWs

High blood pressure	Unadjusted model		Adjusted model	
Variables & categories	**COR [95% CI]**	**P-value**	**AOR [95% CI]**	**P-value**
History of smoking				
Never smoked	1.00 [reference]		1.00 [reference]	
Currently /Ever smoked	1.02 [0.46, 2.27]	0.963	1.59 [0.89, 2.87]	0.120
Have friends or family that smokes				
No	1.00 [reference]		1.00 [reference]	
Yes	1.29 [0.83, 1.99]	0.252	0.98 [0.66, 1.45]	0.911
Exposed to second-hand smoking				
No	1.00 [reference]		1.00 [reference]	
Yes	1.09 [0.74, 1.59]	0.662	0.90 [0.52, 1.54]	0.700
Consumes alcohol				
No	1.00 [reference]		1.00 [reference]	
Yes	1.06 [0.77, 1.45]	0.739	0.93 [0.70, 1.25]	0.648
Work involves vigorous-intensity activities.				
No	1.00 [reference]		1.00 [reference]	
Yes	1.11 [0.84, 1.45]	0.462	0.93 [0.75, 1.17]	0.544
Work involves moderate-intensity activities.				
No	1.00 [reference]		1.00 [reference]	
Yes	1.11 [0.89, 1.38]	0.360	0.93 [0.77, 1.12]	0.432
Walk/cycle daily for at least 10 minutes per day				
No	1.00 [reference]		1.00 [reference]	
Yes	0.92 [0.70, 1.21]	0.558	1.09 [0.84, 1.43]	0.506
Does vigorous-intensity sports				
No	1.00 [reference]		1.00 [reference]	
Yes	0.93 [0.75, 1.15]	0.496	1.12 [0.85, 1.49]	0.421
Does moderate-intensity sports				
No	1.00 [reference]		1.00 [reference]	
Yes	0.94 [0.65, 1.35]	0.741	1.10 [0.77, 1.56]	0.610

Abbreviations: COR: crude odds ratio. AOR: adjusted odds ratios. CI: Confidence interval
Variables controlled in the Adjusted model:
Includes exposure the interaction between exposure to COVID-19 and (month),
Socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.),
Work and professional-related characteristics (Having another part-time job),
Family and personal history of comorbidities (Family history of comorbidities; family history of hypertension, family history of diabetes, have personal history of comorbidities; have diabetes),
Lifestyle characteristics (History of smoking, exposure to second-hand smoking, consuming alcohol, engagement in vigorous physical activities at the workplace, engagement in moderate physical activities at the workplace, walks or cycles for at least 10 minutes daily, engagement in vigorous sports activities, engagement in moderate-intensity sports)

4.8.1 Interacting Effect of Lifestyle in the Relation between COVID-19 and Lung Function

After controlling for other variables in the adjusted model, no statistical significance was observed between lifestyle characteristics, COVID-19, and reduced lung function among HCWs in the exposed group. The results are presented in Table 4.15.

Table 4.14: Multilevel Generalized Logistic Regression Models of the Effect of Lifestyle Characteristics on Reduced Lung Function among HCWs

Reduced lung function	Unadjusted model		Adjusted model	
Variables & categories	**COR [95% CI]**	**P-value**	**AOR [95% CI]**	**P-value**
History of smoking				
Never smoked	1.00 [reference]		1.00 [reference]	
Currently /Ever smoked	0.43 [0.13, 1.35]	0.149	0.43 [0.11, 1.63]	0.214
Have friends or family that smokes				
No	1.00 [reference]		1.00 [reference]	
Yes	1.23 [0.74, 2.05]	0.427	1.31 [0.81, 2.13]	0.277
Exposed to second-hand smoking				
No	1.00 [reference]		1.00 [reference]	
Yes	1.18 [0.91, 1.54]	0.221	1.04 [0.80, 1.36]	0.769
Consumes alcohol				
No	1.00 [reference]		1.00 [reference]	
Yes	0.63 [0.40, 1.01]	0.054	0.76 [0.46, 1.27]	0.296
Work involves vigorous-intensity activities.				
No	1.00 [reference]		1.00 [reference]	
Yes	1.06 [0.80, 1.40]	0.703	1.07 [0.84, 1.35]	0.596
Work involves moderate-intensity activities.				
No	1.00 [reference]		1.00 [reference]	
Yes	0.84 [0.58, 1.22]	0.351	0.91 [0.66, 1.23]	0.530
Walk/cycle daily for at least 10 minutes per day				
No	1.00 [reference]		1.00 [reference]	
Yes	0.73 [0.52, 1.03]	0.070	0.95 [0.69, 1.29]	0.728
Does vigorous-intensity sports				
No	1.00 [reference]		1.00 [reference]	
Yes	0.68 [0.52, 0.90]	0.006	0.98 [0.70, 1.37]	0.919
Does moderate-intensity sports				
No	1.00 [reference]		1.00 [reference]	
Yes	0.79 [0.59, 1.07]	0.124	0.93 [0.70, 1.23]	0.605

NOTES:
Abbreviations: COR: crude odds ratio. AOR: adjusted odds ratios. CI: Confidence interval
Variables controlled in the Adjusted model:
Includes the interaction between exposure to COVID-19 and (month),
Socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.),
Work and professional-related characteristics (Having other part-time job),
Family and personal history of comorbidities (Family history of comorbidities; family history of hypertension, family history of diabetes, have personal history of comorbidities; have diabetes),
Lifestyle characteristics (History of smoking, having friends and family that smoke, exposure to second-hand smoking, consuming alcohol, engagement in vigorous physical activities at the workplace, engagement in moderate physical activities at the workplace, walks or cycles for at least 10 minutes daily, engagement in vigorous sports activities, engagement in moderate-intensity sports)

4.8.2 Interacting Effect of Family/Work-Related Support in the Relation between COVID-19 and Psychological Health

After controlling for other variables in the adjusted model, no statistical significance was observed between family and work-related support and COVID-19 and depression among HCWs in the exposed group. The results are presented in Table 4.16.

Table 4.17 presents the interactive effect of family/work-related support on the relationship between COVID-19 and anxiety. After controlling for other variables in the adjusted model, family and work-related support was not statistically significant for COVID-19 and anxiety among HCWs in the exposed group.

After controlling for other variables in the adjusted model, no statistical significance was observed between family and work-related COVID-19 and stress among HCWs in the exposed group. The results are presented in Table 4.18.

Table 4.15: Multilevel Generalized Ordered Linear Models of the Effect of Family and Workplace Support on Depression among HCWs

Depression level	Unadjusted model		Adjusted model	
Variables & categories	**CPOR [95% CI]**	**P-value**	**APOR [95% CI]**	**P-value**
Have you been seeking the services of a psychologist				
No	1.00 [reference]		1.00 [reference]	
Yes	1.21 [0.74, 1.98]	0.439	1.15 [0.87, 1.51]	0.331
Have Family members to take care of you when you are sick				
Yes	1.00 [reference]		1.00 [reference]	
No/No response	0.94 [0.75, 1.18]	0.609	1.13 [0.92, 1.39]	0.252
Support from colleagues at work				
Low support	1.00 [reference]		1.00 [reference]	
Moderate	0.61 [0.48, 0.77]	<0.001	0.89 [0.71, 1.11]	0.304
High support	0.65 [0.50, 0.85]	0.002	1.11 [0.85, 1.46]	0.445
Support from the immediate supervisor				
Low support	1.00 [reference]		1.00 [reference]	
Moderate	0.64 [0.50, 0.82]	<0.001	1.05 [0.86, 1.28]	0.659
High support	0.70 [0.57, 0.86]	0.001	1.01 [0.82, 1.24]	0.914
Work-related emotional toll				
Low	1.00 [reference]		1.00 [reference]	
Moderate	0.94 [0.72, 1.23]	0.668	0.90 [0.71, 1.13]	0.357
High	1.08 [0.82, 1.42]	0.588	1.05 [0.80, 1.37]	0.747

NOTES:
Abbreviations: CPOR: crude proportional odds ratio. APOR: adjusted proportional odds ratios. CI: Confidence interval
Variables controlled in the Adjusted model:
Includes the interaction between exposure to COVID-19 and (month),
Socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.),
Work and professional-related characteristics (Having another part-time job),
Family and personal history of comorbidities (Family history of comorbidities; family history of hypertension, family history of diabetes, have personal history of comorbidities; have asthma, have diabetes) and,
Family and workplace support (Consulting a psychologist, having family members to take care of respondent when sick, support level from a colleague at the workplace, support level from an immediate supervisor at the workplace, level of work-related emotional toll).

Table 4.16: Multilevel Generalized Ordered Linear Models of the Effect of Family and Workplace Support on Anxiety among HCWs

Anxiety level	Unadjusted model		Adjusted model	
Variables & categories	CPOR [95% CI]	P-value	APOR [95% CI]	P-value
Have you been seeking the services of a psychologist				
No	1.00 [reference]		1.00 [reference]	
Yes	1.09 [0.68, 1.75]	0.724	1.21 [0.94, 1.56]	0.130
Have Family members to take care of you when you are sick				
Yes	1.00 [reference]		1.00 [reference]	
No/No response	0.86 [0.71, 1.05]	0.133	0.99 [0.74, 1.32]	0.948
Support from colleagues at work				
Low support	1.00 [reference]		1.00 [reference]	
Moderate	0.64 [0.52, 0.78]	<0.001	0.86 [0.71, 1.04]	0.131
High support	0.67 [0.50, 0.90]	0.007	0.96 [0.80, 1.16]	0.707
Support from the immediate supervisor				
Low support	1.00 [reference]		1.00 [reference]	
Moderate	0.70 [0.55, 0.90]	0.005	1.15 [0.92, 1.44]	0.223
High support	0.72 [0.57, 0.92]	0.008	1.09 [0.92, 1.29]	0.322
Work-related emotional toll				
Low	1.00 [reference]		1.00 [reference]	
Moderate	0.98 [0.80, 1.19]	0.815	0.93 [0.78, 1.11]	0.407
High	1.17 [0.91, 1.49]	0.218	1.10 [0.89, 1.36]	0.384

NOTES:
Abbreviations: CPOR: crude proportional odds ratio. APOR: adjusted proportional odds ratios. CI: Confidence interval
Variables controlled in the Adjusted model:
Includes the interaction between exposure to COVID-19 and (month),
Socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.),
Work and professional-related characteristics (Having another part-time job),
Family and personal history of comorbidities (Family history of comorbidities; family history of hypertension, family history of diabetes, have personal history of comorbidities; have asthma, have diabetes) and,
Family and workplace support (Consulting a psychologist, having family members to take care of respondent when sick, support level from a colleague at the workplace, support level from an immediate supervisor at the workplace, level of work-related emotional toll).

Table 4.17: Multilevel Generalized Ordered Linear Models of the Effect of Family and Workplace Support on Stress among HCWs

Stress level	Unadjusted model		Adjusted model	
Variables & categories	**CPOR [95% CI]**	**P-value**	**APOR [95% CI]**	**P-value**
Have you been seeking the services of a psychologist				
No	1.00 [reference]		1.00 [reference]	
Yes	1.43 [0.90, 2.28]	0.130	0.73 [0.46, 1.18]	0.198
Have Family members to take care of you when you are sick				
Yes	1.00 [reference]		1.00 [reference]	
No/No response	1.00 [0.83, 1.21]	0.973	1.16 [0.88, 1.53]	0.286
Support from colleagues at work				
Low support	1.00 [reference]		1.00 [reference]	
Moderate	0.56 [0.44, 0.71]	<0.001	0.86 [0.64, 1.16]	0.324
High support	0.61 [0.50, 0.76]	<0.001	1.18 [0.85, 1.63]	0.328
Support from the immediate supervisor				
Low support	1.00 [reference]		1.00 [reference]	
Moderate	0.61 [0.48, 0.77]	<0.001	0.93 [0.73, 1.19]	0.566
High support	0.64 [0.52, 0.78]	<0.001	0.83 [0.61, 1.15]	0.261
Work-related emotional toll				
Low	1.00 [reference]		1.00 [reference]	
Moderate	0.87 [0.66, 1.15]	0.335	0.84 [0.64, 1.09]	0.182
High	0.99 [0.73, 1.34]	0.940	0.98 [0.67, 1.44]	0.929

NOTES:
Abbreviations: CPOR: crude proportional odds ratio. APOR: adjusted proportional odds ratios. CI: Confidence interval
Variables controlled in the Adjusted model:
Includes the interaction between exposure to COVID-19 and (month),
Socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.),
Work and professional-related characteristics (Having another part-time job),
Family and personal history of comorbidities (Family history of comorbidities; family history of hypertension, family history of diabetes, have personal history of comorbidities; have asthma, have diabetes) and,
Family and workplace support (Consulting a psychologist, having family members to take care of respondent when sick, support level from a colleague at the workplace, support level from an immediate supervisor at the workplace, level of work-related emotional toll).

4.8.3 Interacting Effect of Family/Work-Related Support in the Relation between COVID-19 and BP

HCWs in the exposed group who receive moderate support from their immediate supervisors have 51% reduced odds of experiencing high BP compared to others with low support (APOR=0.49; 95%CI=0.32, 0.75). The results on family/work-related support about COVID-19 and BP are presented in Table 4.19.

Table 4.18: Multilevel Generalized Logistic Regression Models of the Effect of Family and Workplace Support on High Blood Pressure among HCWs

High blood pressure	Unadjusted model		Adjusted model	
Variables & categories	**COR [95% CI]**	**P-value**	**AOR [95% CI]**	**P-value**
Have you been seeking the services of a psychologist				
No	1.00 [reference]		1.00 [reference]	
Yes	1.58 [1.14, 2.20]	0.007	1.46 [0.97, 2.19]	0.069
Have Family members to take care of you when you are sick				
Yes	1.00 [reference]		1.00 [reference]	
No/No response	1.12 [0.75, 1.67]	0.570	1.14 [0.79, 1.65]	0.472
Support from colleagues at work				
Low support	1.00 [reference]		1.00 [reference]	
Moderate	0.65 [0.42, 1.00]	0.051	1.01 [0.65, 1.57]	0.971
High support	0.67 [0.52, 0.86]	0.002	1.30 [0.79, 2.15]	0.305
Support from the immediate supervisor				
Low support	1.00 [reference]		1.00 [reference]	
Moderate	0.46 [0.31, 0.69]	<0.001	0.49 [0.32, 0.75]	**0.001**
High support	0.69 [0.52, 0.91]	0.009	0.73 [0.45, 1.18]	0.198
Work-related emotional toll				
Low	1.00 [reference]		1.00 [reference]	
Moderate	0.96 [0.72, 1.30]	0.815	1.18 [0.87, 1.61]	0.284
High	0.90 [0.64, 1.27]	0.558	0.97 [0.69, 1.37]	0.882

NOTES:
Abbreviations: CPOR: crude proportional odds ratio. APOR: adjusted proportional odds ratios. CI: Confidence interval
Variables controlled in the Adjusted model:
Includes the interaction between exposure to COVID-19 and (month),
Socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.),
Work and professional-related characteristics (Having another part-time job),
Family and personal history of comorbidities (Family history of comorbidities; family history of hypertension, family history of diabetes, have personal history of comorbidities; have asthma, have diabetes) and,
Family and workplace support (Consulting a psychologist, having family members to take care of respondent when sick, support level from a colleague at the workplace, support level from an immediate supervisor at the workplace, level of work-related emotional toll).

4.8.4 Interacting Effect of Family/Work-Related Support in the Relation between COVID-19 and Lung Function

After controlling for other variables in the adjusted model, no statistical significance was observed between family and work regarding COVID-19 and reduced lung function among HCWs in the exposed group. The results are presented in Table 4.20.

Table 4.19: Multilevel Generalized Logistic Regression Models of the Effect of Family and Workplace Support on Reduced Lung Function among HCWs

Reduced lung function	Unadjusted model		Adjusted model	
Variables & categories	**COR [95% CI]**	**P-value**	**AOR [95% CI]**	**P-value**
Have you been seeking the services of a psychologist				
No	1.00 [reference]		1.00 [reference]	
Yes	1.05 [0.54, 2.06]	0.883	0.82 [0.46, 1.44]	0.482
Have Family members to take care of you when you are sick				
Yes	1.00 [reference]		1.00 [reference]	
No/No response	1.27 [0.85, 1.89]	0.250	1.32 [0.89, 1.97]	0.173
Support from colleagues at work				
Low support	1.00 [reference]		1.00 [reference]	
Moderate	0.73 [0.45, 1.18]	0.194	1.07 [0.69, 1.67]	0.756
High support	0.59 [0.44, 0.79]	<0.001	1.20 [0.75, 1.93]	0.442
Support from the immediate supervisor				
Low support	1.00 [reference]		1.00 [reference]	
Moderate	0.80 [0.57, 1.12]	0.192	1.21 [0.81, 1.80]	0.343
High support	0.68 [0.52, 0.90]	0.007	1.14 [0.65, 1.98]	0.649
Work-related emotional toll				
Low	1.00 [reference]		1.00 [reference]	
Moderate	0.89 [0.65, 1.21]	0.450	0.86 [0.61, 1.20]	0.375
High	0.87 [0.57, 1.33]	0.523	0.78 [0.48, 1.24]	0.292

NOTES:
Abbreviations: COR: crude odds ratio. AOR: adjusted odds ratios. CI: Confidence interval
Variables controlled in the Adjusted model:
Includes the interaction between exposure to COVID-19 and (month),
Family and personal history of comorbidities (Family history of comorbidities; family history of asthma, have personal history of comorbidities; having asthma),
Lifestyle characteristics (History of smoking, exposure to second-hand smoking, engagement in vigorous physical activities at the workplace, engagement in moderate physical activities at the workplace, walks or cycles for at least 10 minutes daily, engagement in vigorous sports activities, engagement in moderate-intensity sports),

4.8.5 Interacting Effect of Family/Personal History of Comorbidities in the Relation between COVID-19 and Psychological Health

After controlling for other variables in the adjusted model, no statistical significance was observed between family and personal history of a disease, COVID-19, and depression among HCWs in the exposed group. The results are presented in Table 4.21.

Table 4.22 presents information on the interactive effect of family and personal history of a disease on the relationship between COVID-19 and anxiety. After controlling for other variables in the adjusted model, no statistical significance was observed between family and personal history of a disease and COVID-19 and anxiety among HCWs in the exposed group.

HCWs in the exposed group who have a family history of diabetes were 1.26 times more likely to experience severe levels of stress compared to others without a family history of diabetes. (APOR=1.26; 95%CI=1.00, 1.57). The results of the family/personal history of comorbidities about COVID-19 and stress are presented in Table 4.23.

Table 4.20: Multilevel Generalized Ordered Linear Models of the Effect of History of Comorbidity on Depression among HCWs

Depression level	**Unadjusted model**		**Adjusted model**	
Variables & categories	**CPOR [95% CI]**	**P-value**	**APOR [95% CI]**	**P-value**
Family history of a comorbidity				
No	1.00 [reference]		1.00 [reference]	
Yes	1.43 [1.20, 1.69]	**<0.001**	0.97 [0.77, 1.23]	0.817
Family history of hypertension				
No	1.00 [reference]		1.00 [reference]	
Yes	1.36 [1.17, 1.58]	**<0.001**	1.10 [0.86, 1.40]	0.462
Family history of diabetes				
No	1.00 [reference]		1.00 [reference]	
Yes	1.76 [1.42, 2.17]	**<0.001**	1.16 [0.96, 1.41]	0.124
Personal history of comorbidity				
No	1.00 [reference]		1.00 [reference]	
Yes	1.41 [1.04, 1.91]	**0.028**	1.32 [0.98, 1.78]	0.067
Have asthma				
No	1.00 [reference]		1.00 [reference]	
Yes	1.04 [0.42, 2.57]	0.935	0.83 [0.37, 1.87]	0.653
Have diabetes				
No	1.00 [reference]		1.00 [reference]	
Yes	1.33 [0.81, 2.16]	0.256	0.83 [0.50, 1.38]	0.471

NOTES:
Abbreviations: CPOR: crude proportional odds ratio. APOR: adjusted proportional odds ratios. CI: Confidence interval
Variables controlled in the Adjusted model:
Includes the interaction between exposure to COVID-19 and (month),
Socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.),
Family and personal history of comorbidities (Family history of comorbidities; family history of hypertension, family history of diabetes, have personal history of comorbidities; have asthma, have diabetes) and,
Lifestyle characteristics (History of smoking, exposure to second-hand smoking, consuming alcohol, engagement in vigorous physical activities at the workplace, engagement in moderate physical activities at the workplace, walks or cycles for at least 10 minutes daily, engagement in vigorous sports activities, engagement in moderate-intensity sports)

Table 4.21: Multilevel Generalized Ordered Linear Models of the Effect of History of Comorbidity on Anxiety among HCWs

Anxiety level	Unadjusted model		Adjusted model	
Variables & categories	**CPOR [95% CI]**	**P-value**	**APOR [95% CI]**	**P-value**
Family history of comorbidities				
No	1.00 [reference]		1.00 [reference]	
Yes	1.26 [1.08, 1.47]	0.004	0.92 [0.75, 1.12]	0.401
Family history of hypertension				
No	1.00 [reference]		1.00 [reference]	
Yes	1.21 [1.04, 1.41]	0.016	1.12 [0.90, 1.39]	0.325
Family history of diabetes				
No	1.00 [reference]		1.00 [reference]	
Yes	1.42 [1.16, 1.74]	0.001	0.95 [0.81, 1.12]	0.576
Personal history of comorbidities				
No	1.00 [reference]		1.00 [reference]	
Yes	1.16 [0.91, 1.49]	0.225	1.30 [0.94, 1.79]	0.108
Have asthma				
No	1.00 [reference]		1.00 [reference]	
Yes	0.76 [0.39, 1.51]	0.435	0.59 [0.30, 1.14]	0.114
Have diabetes				
No	1.00 [reference]		1.00 [reference]	
Yes	1.36 [0.91, 2.03]	0.132	1.16 [0.79, 1.70]	0.451

NOTES:
Abbreviations: CPOR: crude proportional odds ratio. APOR: adjusted proportional odds ratios. CI: Confidence interval
Variables controlled in the Adjusted model:
NOTES:
Abbreviations: CPOR: crude proportional odds ratio. APOR: adjusted proportional odds ratios. CI: Confidence interval
Variables controlled in the Adjusted model:
Includes the interaction between exposure to COVID-19 and (month),
Socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.),
Family and personal history of comorbidities (Family history of comorbidities; family history of hypertension, family history of diabetes, have personal history of comorbidities; have asthma, have diabetes) and,
Lifestyle characteristics (History of smoking, exposure to second-hand smoking, consuming alcohol, engagement in vigorous physical activities at the workplace, engagement in moderate physical activities at the workplace, walks or cycles for at least 10 minutes daily, engagement in vigorous sports activities, engagement in moderate-intensity sports)

Table 4.22: Multilevel Generalized Ordered Linear Models of the Effect of History of Comorbidity on Stress among HCWs

Stress level	Unadjusted model		Adjusted model	
Variables & categories	**CPOR [95% CI]**	**P-value**	**APOR [95% CI]**	**P-value**
Family history of comorbidities				
No	1.00 [reference]		1.00 [reference]	
Yes	1.45 [1.21, 1.74]	<0.001	0.97 [0.77, 1.21]	0.786
Family history of hypertension				
No	1.00 [reference]		1.00 [reference]	
Yes	1.39 [1.19, 1.62]	<0.001	1.08 [0.85, 1.37]	0.547
Family history of diabetes				
No	1.00 [reference]		1.00 [reference]	
Yes	1.80 [1.38, 2.33]	<0.001	1.26 [1.00, 1.57]	**0.045**
Personal history of comorbidities				
No	1.00 [reference]		1.00 [reference]	
Yes	1.18 [0.88, 1.57]	0.269	0.93 [0.70, 1.24]	0.617
Have asthma				
No	1.00 [reference]		1.00 [reference]	
Yes	0.88 [0.31, 2.55]	0.818	0.84 [0.48, 1.45]	0.524
Have diabetes				
No	1.00 [reference]		1.00 [reference]	
Yes	1.31 [0.87, 1.98]	0.193	1.30 [0.75, 2.24]	0.353

NOTES:
Abbreviations: CPOR: crude proportional odds ratio. APOR: adjusted proportional odds ratios. CI: Confidence interval
Variables controlled in the Adjusted model:
NOTES:
Abbreviations: CPOR: crude proportional odds ratio. APOR: adjusted proportional odds ratios. CI: Confidence interval
Variables controlled in the Adjusted model:
Includes the interaction between exposure to COVID-19 and (month),
Socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.),
Family and personal history of comorbidities (Family history of comorbidities; family history of hypertension, family history of diabetes, have personal history of comorbidities; have asthma, have diabetes) and,
Lifestyle characteristics (History of smoking, exposure to second-hand smoking, consuming alcohol, engagement in vigorous physical activities at the workplace, engagement in moderate physical activities at the workplace, walks or cycles for at least 10 minutes daily, engagement in vigorous sports activities, engagement in moderate-intensity sports)

4.8.6 Interacting Effect of Family/Personal History of Comorbidities in the Relation between COVID-19 and BP

After controlling for other variables in the adjusted model, no statistical significance was observed between family/personal history of comorbidity to COVID-19 and high blood pressure among HCWs in the exposed group. The results are presented in Table 4.24.

Table 4.23: Multilevel Generalized Logistic Regression Models of the Effect of History of Comorbidities on High BP among HCWs

High blood pressure	Unadjusted model		Adjusted model	
Variables & categories	**COR [95% CI]**	**P-value**	**AOR [95% CI]**	**P-value**
Family history of comorbidities				
No	1.00 [reference]		1.00 [reference]	
Yes	1.70 [1.35, 2.15]	**<0.001**	1.02 [0.74, 1.41]	0.892
Family history of hypertension				
No	1.00 [reference]		1.00 [reference]	
Yes	1.67 [1.23, 2.26]	**0.001**	1.10 [0.80, 1.52]	0.560
Family history of diabetes				
No	1.00 [reference]		1.00 [reference]	
Yes	1.45 [1.07, 1.97]	**0.017**	1.28 [0.75, 2.19]	0.373
Personal history of comorbidities				
No	1.00 [reference]		1.00 [reference]	
Yes	1.82 [1.01, 3.27]	**0.045**	1.38 [0.62, 3.06]	0.429
Have asthma				
No	1.00 [reference]		1.00 [reference]	
Yes	1.47 [0.40, 5.37]	0.561	0.95 [0.21, 4.33]	0.942
Have diabetes				
No	1.00 [reference]		1.00 [reference]	
Yes	2.09 [1.22, 3.58]	**0.007**	1.36 [0.57, 3.28]	0.491

NOTES:
Abbreviations: COR: crude odds ratio. AOR: adjusted odds ratios. CI: Confidence interval
Variables controlled in the Adjusted model:
NOTES:
Abbreviations: CPOR: crude proportional odds ratio. APOR: adjusted proportional odds ratios. CI: Confidence interval
Variables controlled in the Adjusted model:
Includes the interaction between exposure to COVID-19 and (month),
Socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.),
Family and personal history of comorbidities (Family history of comorbidities; family history of hypertension, family history of diabetes, have personal history of comorbidities; have asthma, have diabetes) and,
Lifestyle characteristics (History of smoking, exposure to second-hand smoking, consuming alcohol, engagement in vigorous physical activities at the workplace, engagement in moderate physical activities at the workplace, walks or cycles for at least 10 minutes daily, engagement in vigorous sports activities, engagement in moderate-intensity sports)

4.8.7 Interacting effect of Family/Personal History of comorbidity in the Relation between COVID-19 and Lung Function

HCWs in the exposed group who have a family history of diabetes are 3.54 times more likely to experience reduced lung function compared to others without a family history of diabetes (AOR=3.54; 95%CI=1.01, 12.45). Table 4.25 presents the results of the family/personal history of comorbidity in relation to COVID-19 and stress.

Table 4.24: Multilevel Generalized Logistic Regression Models of the Effect of History of Comorbidity on Reduced Lung Function among HCWs

Reduced lung function	Unadjusted model		Adjusted model	
Variables & categories	**COR [95% CI]**	**P-value**	**AOR [95% CI]**	**P-value**
Family history of comorbidity				
No	1.00 [reference]		1.00 [reference]	
Yes	1.40 [1.04, 1.88]	0.026	1.04 [0.69, 1.57]	0.855
Family history of hypertension				
No	1.00 [reference]		1.00 [reference]	
Yes	1.23 [0.88, 1.71]	0.232	0.80 [0.47, 1.36]	0.409
Family history of diabetes				
No	1.00 [reference]		1.00 [reference]	
Yes	1.85 [1.36, 2.51]	<0.001	0.99 [0.68, 1.45]	0.961
Personal history of comorbidity				
No	1.00 [reference]		1.00 [reference]	
Yes	1.21 [0.75, 1.95]	0.445	0.71 [0.30, 1.66]	0.423
Have asthma				
No	1.00 [reference]		1.00 [reference]	
Yes	0.90 [0.20, 3.92]	0.884	0.68 [0.11, 4.30]	0.684
Have diabetes				
No	1.00 [reference]		1.00 [reference]	
Yes	2.49 [1.23, 5.02]	0.011	3.54 [1.01, 12.45]	**0.049**

NOTES:
Abbreviations: COR: crude odds ratio. AOR: adjusted odds ratios. CI: Confidence interval
Variables controlled in the Adjusted model:
NOTES:
Abbreviations: CPOR: crude proportional odds ratio. APOR: adjusted proportional odds ratios. CI: Confidence interval
Variables controlled in the Adjusted model:
Includes the interaction between exposure to COVID-19 and (month),
Socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.),
Family and personal history of comorbidities (Family history of comorbidities; family history of hypertension, family history of diabetes, have personal history of comorbidities; have asthma, have diabetes) and,
Lifestyle characteristics (History of smoking, exposure to second-hand smoking, consuming alcohol, engagement in vigorous physical activities at the workplace, engagement in moderate physical activities at the workplace, walks or cycles for at least 10 minutes daily, engagement in vigorous sports activities, engagement in moderate-intensity sports)

4.9 Results for Objective 3: The Effect of COVID-19 on Presenteeism among HCWs

Most HCWs in the exposed group (79.4%) reported high presenteeism at month 0 (79.4%). This increased to 91.7% in month 6 and was reduced to 76.2% by the 6th month. Presenteeism was statistically significant at baseline ($x^2 = 33.94, p < 0.001$) and endline (x^2=8.11, p=0.004). Details of the results are presented in Figure 4.13

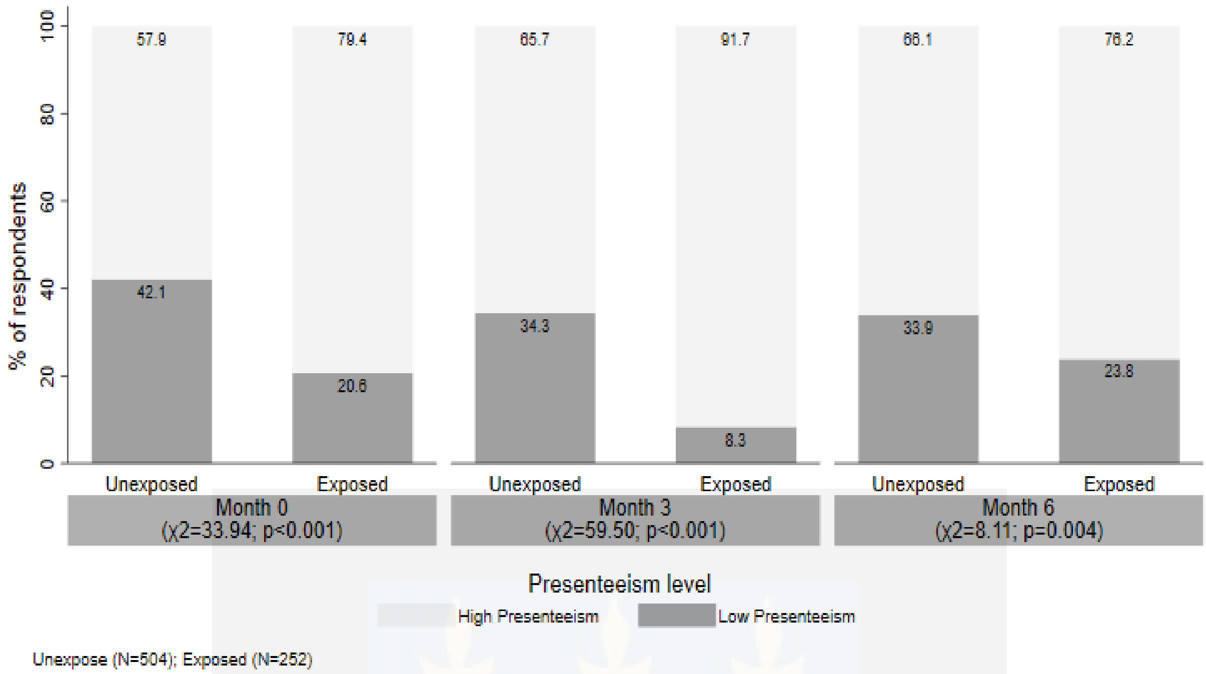

Figure 4.13: Presenteeism Level between the Exposed and Unexposed at Month 0, 3 & 6

4.9.1 Multilevel Association between COVID-19 Exposure and Time and Presenteeism

The results on COVID-19 exposure and time on presenteeism among healthcare workers are presented in Table 4.26.

There was no statistical significance between HCWs exposed to COVID-19 and presenteeism.

Table 4.25: Multilevel Generalized Ordered Linear Models of the Effect of COVID-19 Exposure and Time on Low Presenteeism

Low presenteeism	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Variables & categories	**COR [95% CI]**	**AOR [95% CI]**	**AOR [95% CI]**	**AOR [95% CI]**	**AOR [95% CI]**	**AOR [95% CI]**	**AOR [95% CI]**	**AOR [95% CI]**
Exposure status								
Unexposed	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Exposed	0.42 [0.26, 0.67] ***	0.70 [0.42, 1.18]	0.71 [0.43, 1.18]	0.71 [0.42, 1.20]	0.73 [0.43, 1.23]	0.74 [0.43, 1.28]	0.77 [0.45, 1.31]	0.78 [0.46, 1.33]
Month								
Month 0	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]	1.00 [reference]
Month 3	0.77 [0.54, 1.10]	0.67 [0.48, 0.93] *	0.67 [0.48, 0.95] *	0.69 [0.49, 0.97] *	0.68 [0.48, 0.96] *	0.69 [0.48, 0.97] *	0.68 [0.48, 0.96] *	0.67 [0.47, 0.94] *
Month 6	0.76 [0.58, 0.99] *	0.58 [0.46, 0.74] ***	0.59 [0.46, 0.76] ***	0.61 [0.48, 0.78] ***	0.60 [0.47, 0.77] ***	0.60 [0.47, 0.77] ***	0.59 [0.46, 0.76] ***	0.59 [0.46, 0.76] ***
Interaction Exposure*Month								
Exposed*Month 3	0.49 [0.22, 1.09]	0.47 [0.22, 1.01]	0.47 [0.22, 1.00]	0.47 [0.22, 1.00] *	0.47 [0.22, 1.01]	0.47 [0.22, 1.01]	0.47 [0.22, 1.02]	0.48 [0.22, 1.03]
Exposed*Month 6	1.56 [1.01, 2.39] *	1.23 [0.74, 2.03]	1.22 [0.73, 2.03]	1.25 [0.76, 2.05]	1.27 [0.78, 2.09]	1.26 [0.76, 2.08]	1.26 [0.76, 2.08]	1.23 [0.74, 2.05]
Marginal effects								
Unexposed @ month0	1.00	1.00	1.00	1.00	1.00		1.00	1.00

Abbreviations: COR: crude odds ratio. AOR: adjusted odds ratios. CI: Confidence interval
P-value notation: p<0.005*, p<0.01**, p<0.001**
Model 1: Unadjusted odds ratio. (No covariate adjustments made)
Model 2: Includes exposure variable, month, interaction between exposure and health outcome variables (Depression, Anxiety, high blood pressure and reduced lung function)
Model 3: All variables from **Model 2** and socio-demographic factors (Age group, Sex of respondent, Highest education, Religion, Marital status, and number of dependents.)
Model 4: All variables from **Model 3** and work and professional related characteristics (Having other workplace, Profession and years worked)
Model 5: All variables from **Model 4** and family and personal history of chronic conditions (Family history of comorbidities; family history of hypertension, family history of diabetes, have personal history of comorbidities; have asthma, have diabetes)
Model 6: All variables from **Model 5** and lifestyle characteristics (History of smoking, having friends and family that smoke, exposure to second-hand smoking, consumption of alcohol, engagement in vigorous physical activities at workplace, engagement in moderate physical activities at workplace, walks or cycles for at least 10 minutes daily, engagement in vigorous sports activities, engagement in moderate-intensity sports)
Model 7: All variables from **Model 6** and family and workplace support (Consulting a psychologist, having family members take care of the respondent when sick, support level from colleagues at the workplace, support level from an immediate supervisor at the workplace, level of work-related emotional toll).
Model 8: All variables from **Model 7** and COVID-19 related characteristics and symptoms (Number of COVID-19 tests done before baseline, reason for conducting COVID-19 test, Time to receive COVID-19 test results, COVID-19 vaccination status, and experience of fever, difficulty in breathing, fatigue, and diarrhoea before conducting COVID-19 test)

CHAPTER FIVE

DISCUSSION

5.1 Main Findings

This study explored the impact of COVID-19 on healthcare workers' health and work output in selected hospitals within the Greater Accra region of Ghana. The findings show that the majority of the HCWs developed a milder form of COVID-19 and hence did not require admission. The drug of choice was mainly Vitamin-C and Zinc tablets while the majority of them also complement the orthodox medications with herbal remedies, preferably neem tree concoction and steam inhalation. Again, personal history of comorbidities, smoking, and alcohol were significantly associated with experiencing severe COVID-19 infection

The multilevel analysis demonstrated a significant association between depression, being previously married, HCWs with 1 – 2 dependents, those with other part-time jobs, and being a Pharmacist. Furthermore, experiencing anxiety showed a significant association with HCWs with tertiary education, those with other part-time jobs, being a Pharmacist, and those with 10 – 15 years of work experience. In addition, a significant association was demonstrated between stress and HCWs in the 40 – 49 years age bracket, those who were previously married and engaging in other part-time jobs. Furthermore, having a bachelor's degree or higher was significantly associated with experiencing high blood pressure after contracting COVID-19 among HCWs. Also, normal lung function was observed at baseline and midline among HCWs who are single.

Poor lifestyle choices (exposure to second-hand smoking and consuming alcohol) were significantly associated with depression and anxiety among HCWs who contracted COVID-19. Yet, HCWs who received moderate support from their immediate supervisors experienced normal blood pressure levels. This was significantly associated. A significant association was observed between HCWs who have a family history of diabetes and severe levels of stress. Similarly, a significant association was observed between HCWs who have a family history of diabetes and reduced lung function. The bivariate analysis demonstrated a significant association between exposure to COVID-19 and presenteeism at the end but no statistical significance was observed for the multilevel analysis. In addition, reduced odds of experiencing low levels of presenteeism were observed among HCWs with severe levels of depression. Furthermore, increased odds of experiencing high levels of presenteeism were reported among HCWs with severe levels of anxiety.

5.2 Methodological Validity

The study has several strengths. To the best of the knowledge of the researcher, this is the first time research assessing the impact of COVID-19 on the health and work output of HCWs in Ghana and Africa as a whole has been done, thus the findings will serve as a baseline for assessing COVID-19- related complications among HCWs after recovering from the disease, and help develop a pathway to monitor and provide comprehensive medical assessments and multidisciplinary rehabilitation even after surviving the disease.

Again, the sample size was huge (756), making it easier to generalize the findings to the study population, increasing the study's statistical power, and minimizing selection bias.

Furthermore, the cohort study design allowed the use of past information, study it during the present, and continue to follow up in the future. This approach ensured minimal lost to follow-up and, by extension, reduced information bias. The data collected retrospectively helped assess the risk factors of COVID-19-related complications, while the prospective data facilitated real-time tracking of the outcomes, leading to current and accurate data.

Furthermore, the data captured retrospectively and prospectively helped increase the study's statistical power and helped detect the various associations.

Again, confounding factors controlled for in the analysis were based on the statistical significance of <0.05 with the COVID-19 status (outcome of interest) and were consistent with the literature (Al Abri et al. 2021).

Also, validated questionnaires (DASS-21 and Sanford Presenteeism scale) were used in assessing psychological health and presenteeism, making the results of the study reliable. Also, the COVID-19 status of HCWs was clinically confirmed by an RT-PCR test; hence, differential misclassification was unlikely. In addition, the lung function and blood pressure monitoring of the HCWs were determined after a spirometry test and blood pressure monitoring were done by the researcher. This approach ensured that the true state of the healthcare workers' lung function and blood pressure was determined, thereby reducing recall bias.

These strengths notwithstanding, some limitations of the study are acknowledged. The study used purposive sampling and focused on healthcare workers (nurses, doctors, laboratory scientists, and pharmacists) in selected hospitals in the Greater Accra Region. Hence, the findings cannot be generalized to all HCWs and hospitals in Ghana. This limitation was reduced by ensuring the sample size was big enough to generalize the findings to the study population.

In addition, the participants were followed up for a period of 6-months. Though the 6-month follow-up period was enough to have some of the outcome of interest (depression, anxiety, stress, reduced lung function, and presenteeism) manifesting, this limited time could have affected the time period of manifesting some of the post-COVID-19 complications, as a disease like hypertension may take years to develop.

Information on the impact of COVID-19 on the health and work output of healthcare workers was explored with a self-reported questionnaire. Hence, the result may be affected by recall bias. This limitation was however reduced by the use of a validated questionnaire, as well as the interview skills of the researcher to elicit certain responses indirectly.

5.3 Comparisons of Findings with Previous Studies

This section discusses the findings based on the results. It compares the findings from the present study with previous studies on the subject under consideration and is based on the study's specific objectives.

5.3.1 Clinical Characteristics and Management of COVID-19 among HCWs

This objective comprehensively explains the clinical attributes, hospitalization status, pharmaceutical interventions, and laboratory assessments employed in managing COVID-19 among 252 healthcare workers (HCWs). Predominant signs and symptoms among HCWs included cold, cough, loss of taste, fever, headache, and fatigue. Most (88%) participants experienced a mild form of the disease, not requiring hospital admission, with vitamin C and Zinc being commonly utilized supplements. Azithromycin emerged as the predominant antibiotic. In addition to conventional medications, a substantial number of HCWs extensively relied on herbal remedies, particularly neem tree concoctions and steam inhalation. These findings are particularly relevant for healthcare systems in developing nations where investigations into the clinical attributes of herbs in the management of diseases like COVID-19 is underdeveloped.

Contrary to previous studies indicating a higher susceptibility to COVID-19 among males than females, the current study demonstrated a higher infection rate among female HCWs. For example, severe COVID-19 was more prevalent among females in this study, contrasting with findings in Turkish HCWs (Madran et al., 2022)This divergence may be attributed to the predominance of female HCWs in Ghanaian healthcare facilities. The age range of participants, predominantly between 30-39 years, aligns with similar findings in Iran, where HCWs aged 25-35 years were notably infected with COVID-19 disease (Sabetian et al., 2021). This concurrence could be that most of the HCWs were youthful and perceived that COVID-19 affected older individuals more severely than the younger population as they exhibited better immunity.

Again, the majority of participants being married correlates with studies indicating the pivotal role of marriage in the recovery process post-COVID-19 contraction (Jace & Makridis, 2021; Wang et al., 2020). Marriage often offers psychological support, facilitating swift recuperation and bolstering the mental resilience necessary for effective work performance after disease recovery. The acquisition of adequate education plays a pivotal role in comprehending the causation, transmission, treatment, and prevention of COVID-19. Education contributes to behaviour modifications vital for disease prevention and encourages individuals with COVID-19-related complications to seek prompt medical care following diagnosis (Bielicki et al., 2020). In line with these observations, our study found that most HCWs held at least a bachelor's degree or higher, signifying a correlation between education level and the disease's understanding and management. Despite HCWs' knowledge of infection prevention and control measures, they remained vulnerable to COVID-19 exposure due to the nature of their work.

Several respondents reported comorbidities such as diabetes, hypertension, asthma, mental illness, renal disease, and sickle cell disease. Consistent with our findings, studies have consistently indicated that individuals with comorbidities face an elevated risk of developing COVID-19 (Jin et al., 2020; Ministry of Health, 2020). Comorbidities were significantly associated with milder forms of the disease, aligning with a previous study (Díez-Manglano et al., 2021) reporting fewer comorbidities among hospitalized HCWs compared to non-healthcare workers. These underlying conditions often compromise an individual's immunity, intensifying susceptibility to COVID-19-related complications. This finding aligns with other studies (Madran et al., 2022; Mhango et al., 2020), underscoring the significant role of pre-existing medical conditions as key risk factors for COVID-19. The severity of the disease significantly influences the recovery process, emphasizing the critical role of pre-existing medical conditions in COVID-19 outcomes.

Furthermore, our study highlighted a heightened risk of severe COVID-19 among individuals with a history of smoking and alcohol consumption. This underscores the impact of unhealthy lifestyles among HCWs, potentially magnifying their susceptibility to severe COVID-19 (Moustafa et al., 2022). Chronic alcohol consumption and smoking can significantly compromise the immune system of HCWs, making them more susceptible to deteriorating health upon contracting the disease. Therefore, HCWS must exercise caution in their lifestyle choices, given that the health and well-being of the wider population rely on their continued availability and health.

HCWs in Wuhan, China, exposed to COVID-19 commonly manifested symptoms such as fever, dry cough, dyspnea, sore throat, and fatigue, consistent with our study's findings (Wang et al., 2020). The reported signs and symptoms provide a snapshot of the clinical presentation among HCWs. Cold symptoms and cough were prevalent, consistent with respiratory manifestations commonly associated with COVID-19. Loss of taste and fever were also notable, aligning with recognized COVID-19 symptoms. These findings underscore the importance of recognizing a broad spectrum of symptoms for effective screening and diagnosis.

Moreover, most participants tested positive for COVID-19 during their initial test. This supports the efficacy of the RT-PCR test in detecting asymptomatic cases. However, when utilizing the Rapid Diagnostic Test (RDT), the need for multiple tests arises due to its intrinsic lower sensitivity in a single test (Barboza et al., 2021; Jin et al., 2020).

Although existing literature lacks a definitive effective treatment protocol for COVID-19 (Brurberg & Fretheim, 2020; Saki et al., 2020; Wang et al., 2020) certain medications have shown efficacy in managing the viral infection (Brurberg & Fretheim, 2020; Wang et al., 2020; Wang et al., 2020) Antimicrobials and corticosteroids are among the classes of drugs prescribed to manage COVID-19 symptoms. In Ghana, the standard treatment protocol for COVID-19 involves a combination of Azithromycin and Doxycycline supplemented with Vitamins C and Zinc or the individual use of either Azithromycin or Doxycycline (Ried et al., 2021; Wang et al., 2020). Our study aligns with these practices, revealing that HCWs commonly use Vitamins C and Zinc, Azithromycin, and Doxycycline for treating COVID-19.

Surprisingly, more than half of the HCWs in our study relied on herbal medicine as an alternative to orthodox medicine for COVID-19 treatment, with neem tree concoction/steam inhalation being the preferred choice. This contradicts standard medical advice advocating for prescribed medications. While certain indigenous medicinal plants have demonstrated effectiveness against various viral infections, including pneumonia and measles in Ghana (Hajimonfarednejad et al., 2023), the uncertainties surrounding COVID-19 during its initial wave prompted many individuals to explore these remedies. Steam inhalation and neem tree concoctions, long-standing traditional treatments for various diseases in Ghana, including malaria, were resorted to in a bid to combat the disease. However, caution is warranted as some of these concoctions lack extensive investigation regarding safety and efficacy in human use (Appiah et al., 2022).

Asymptomatic patients are less likely to develop moderate to severe symptoms, often not requiring admission or hospitalization (Cao et al., 2020). In concordance, this study revealed that most HCWs infected with the virus were not hospitalized but resumed regular activities. However, hospital management should ensure that these HCWs recover fully before resuming work to prevent potential spread to their colleagues (Ashinyo et al., 2021). While previous studies have commonly associated COVID-19-related hospitalizations with pre-existing comorbidities, our investigation revealed that the majority of participants in our study did not require hospital admission and were instead managed at home until recovery. This pattern could be linked to the participants' relatively active and youthful profile, with a significant proportion falling within the age bracket of 30 to 39 years. Notably, our investigation revealed that most individuals experiencing severe forms of the disease, necessitating hospitalization, had been fully vaccinated. This finding contradicts prior research (Havers, et al., 2022), indicating a higher hospitalization rate among the unvaccinated compared to the vaccinated. A significant portion of respondents (75%) had received the full dose of the COVID-19 vaccine. This high vaccination rate within the healthcare workforce is encouraging, indicating a commitment to personal and collective protection. The relatively modest percentage (13%) testing positive after vaccination suggests a commendable level of vaccine efficacy while prompting inquiries about breakthrough infections. Further exploration of factors contributing to breakthrough cases, such as new variants' emergence or booster dose delays, would enhance our understanding (Amanatidou et al., 2022).

This study enrolled healthcare workers (HCWs) who had previously tested positive for COVID-19 using RT-PCR. Among those with comorbidities, a predominant proportion had a history of diabetes. During the active phase of the disease, prevalent signs and symptoms included common cold, cough, loss of taste, fever, headache, and fatigue. The participants primarily consisted of youthful individuals who tested positive for COVID-19 upon their initial test and did not require hospital admission. Commonly utilized supplements and medications among HCWs encompassed vitamins C/Zinc and Azithromycin/Doxycycline, respectively.

Additionally, more than half of the participants used herbal remedies, predominantly neem tree concoctions or steam inhalation, to treat COVID-19. Notably, individuals with comorbidities experienced milder forms of the disease, while those with a history of smoking or alcohol consumption experienced more severe manifestations of COVID-19. The health status of HCWs is paramount to the sustainability of healthcare systems. To safeguard HCWs, providing comprehensive training in IPC practices and ensuring stringent adherence to these measures within healthcare facilities is imperative. Given their frequent interactions with patients from the community, HCWs should consistently have access to PPE to mitigate their exposure risk to COVID-19. Encouraging HCWs to receive full COVID-19 vaccination and promoting healthy lifestyles are vital. However, protecting HCWs without simultaneously implementing robust measures to safeguard the community might lead to adverse consequences, considering that patients seeking healthcare are part of the community. Therefore, community education on adherence to COVID-19 safety protocols, vaccination importance, and embracing healthy habits becomes pivotal in reducing the risk of disease transmission. Further studies exploring the clinical attributes and management of COVID-19 among HCWs, encompassing laboratory and imaging findings, are strongly recommended to enhance our understanding of the disease dynamics in healthcare settings.

5.3.2 Effect of COVID-19 on the Psychological Health of HCWs

The findings demonstrated a significant association between depression, anxiety, stress, and being previously married. The findings corroborate that individuals' marital status, such as with

HCWs, is central to their recovery after contracting the coronavirus (Jin et al., 2020; Ministry of Health, 2020). The similarity in the findings can be attributed to the fact that being married provides psychological support for prompt recovery while also providing the psychological fortitude to deliver at work after recovering from the virus (COVID-19). In addition, the findings demonstrated a significant association between depression and HCWs with tertiary education. Then again, in understanding the cause, mode of transmission, treatment available, and prevention of COVID-19, the level of education is very important. Adequate knowledge is key to preventing and identifying COVID-19-associated complications in seeking medical care (Yu et al. 2020). The demographics of HCWs are central to their swift recovery from COVID-19.

Furthermore, HCWs exposed to COVID-19 experience stress, which has a detrimental effect on every area of health. This is not surprising as HCWs operating on the front lines at the peak of the COVID-19 pandemic have had to manage many patients' workloads. The finding is consistent with a cross-sectional study focused on frontline nurses taking care of COVID-19 patients, which found that frontline nurses experienced significant levels of emotional stress when providing care for COVID-19 patients (Hu et al., 2020). The similarity in the findings is attributed to the significant incidence of stress among HCWs as a result of the rise in COVID-19 patients. This increase in patient demand can dramatically impact the risk that a nurse may experience stress.

Additionally, the present study found a significant association between anxiety and HCWs exposed to COVID-19. This result is consistent with a study that measured exposure, perception, and anxiety levels among participants in 60 countries. As a result of their stress while working during the pandemic, 51.4% of participants in the study in 33 countries stated that they experienced emotional fatigue (Azoulay et al., 2020) as a result of receiving insufficient PPE (45.2%), having no access to mental healthcare (52.2%), and not receiving COVID-19-specific training (53.1%). The similarity in the findings can be attributed to the lack of access to any of these alternatives for the HCWs; all of these factors influenced their anxiety levels. Also, the pandemic's many contributing elements, including the rise in demand for longer work and hours, contributing factors to the high anxiety levels experienced by the HCWs. Furthermore, the study also noted a greater incidence of depression (26.3%) and anxiety (29%) traits in HCWs (Salazar de Pablo et al., 2020). In addition, HCWs reported feeling stigmatized more frequently than the general population. (Salazar de Pablo, et al, 2020). Because these HCWs interact with COVID-19 patients, several reported that their friends and family have shied away from them for fear of getting the virus. This could make HCWs feel cut off from their network of support, which hurts their mental health. This notwithstanding, one systematic study discovered that HCWs had a strong sense of responsibility and devotion to patient care despite their daily difficulties. According to this study, nurses still felt a strong obligation to do their professional duties throughout this epidemic, notwithstanding how dangerous the situation is (Fernandez et al., 2020). Many of these nurses took great pleasure in their professionalism. They believed they still had duties to fulfil despite the risk of infection, eventually demonstrating a strong dedication to patient care. Because many must decide between exposing themselves to patients or their families, this dedication raises ethical and moral questions. This sacrifice is still impacting healthcare practitioners' psychological health.

5.3.3 Effect of COVID-19 on Blood Pressure among HCWs

Due to its prevalence among COVID-19 patients, hypertension has grown in prominence among researchers (Schiffrin et al., 2020). It is the most frequent co-morbidity seen in COVID-19 patients, with rates ranging from 15 to 30%, according to observational and retrospective studies carried out close to Wuhan (Wang et al., 2020a; Zhang et al., 2020c; Zhou et al., 2020).

One of the largest trials, involving 1,099 COVID-19 patients, was conducted in Wuhan between December 11, 2019, and January 29, 2020. Of these patients, 1 5 (or 15%) had high blood pressure. The same study also revealed that 13.4% of people with normotension and 23.7% of hypertension patients had more severe illnesses overall (Guan et al., 2020b). This contradicts findings from the present study, which established that 90% of HCWs in the 20 – 29 age bracket experienced normal BP levels at baseline.

A high prevalence (31.2%) of hypertension was found in 138 laboratory-confirmed COVID-19 patients in a different research conducted in China. Additionally, the researchers discovered that 58.3% of COVID-19-infected hypertensive patients were admitted to intensive care units (ICUs), compared to 21.6% of individuals with normal blood pressure (Wang et al., 2020a). Pre-existing hypertension was independently linked to severe COVID-19 in a population of 1,590 patients from 575 institutions (hazard ratio 1.575, 95% CI: 1.07-2.32) (Guan et al., 2020a). Overall, the results show that individuals with hypertension are more likely to experience severe COVID-19 outcomes. This does not agree with findings from the present study, which found that most HCWs experienced normal BP levels at baseline. This could be attributed to the fact that most HCWs were young and understood the importance of checking, monitoring, and maintaining good blood pressure levels amidst the COVID-19 virus that attacks immune-suppressed individuals. Since these HCWs worked closely with COVID-19 patients, it was important those with comorbidities, including hypertension, were closely monitored and put in the less stressful zone to reduce the risk of having an elevated BP.

Findings from the study established a significant association between comorbidities (hypertension and diabetes) and blood pressure among healthcare workers. This is consistent with a study in China, which found that hypertension was a reliable predictor of outcome only when combined with diabetes or another risk factor (Sun et al., 2020). The findings from the present study also agree with some studies (Gupta et al., 2020; Giannouchos et al., 2020), which found a correlation between either hypertension or diabetes and poor outcomes in COVID-19 patients. According to Bauer et al. (2020), hypertension was only a significant independent predictor of a severe form of COVID-19 among individuals under the age of 65 and not across board in the research group. Conversely, among patients under 65 and all individuals, diabetes and congestive heart failure were independent predictors. With 15,794 patients, the study found that diabetes and hypertension alone were significant predictors of ICU admission and death, but not severe COVID-19 (Barrera et al. 2020). Interestingly, severe COVID-19 was not predicted by concurrent hypertension and diabetes. This is contrary to findings from the present study, which found that hypertension and diabetes were predictors of blood pressure levels among HCWs at the end of the study.

According to a study that involved approximately 4,000 critically sick COVID-19 patients who were admitted to the ICU, comorbidities such as high blood pressure, diabetes, cardiovascular disease, hypercholesterolemia, chronic renal disease, and others were indicators of death in these patients (Grasselli et al., 2020). This disagrees with findings from the present study, which found that diabetes, hypertension, and renal disease were significantly associated with normal blood pressure levels among the HCWs. According to a research study that only included hypertensive individuals, age and chronic renal disease were the only independent predictive factors, but diabetes was not (Denova-Gutiérrez et al., 2020). This is consistent with the findings from the present study, which found that age and renal disease were significant predictors of blood pressure at baseline and end line.

According to research conducted by Ran et al. (2020) on 803 COVID-19-positive hypertensive patients in China, average systolic blood pressure is the only factor that may independently predict the development of heart failure in these individuals. Higher chances of death and ICU admission were also strongly correlated with increased BP fluctuation. The authors demonstrated that patients with high systolic blood pressure had considerably higher odds of developing COVID-19-induced heart failure. At the same time, this tendency was less pronounced in individuals with high diastolic blood pressure (Ran et al., 2020). This study demonstrates that high blood pressure is a significant predictor of unfavourable outcomes and that systolic blood pressure should be the main focus of BP control in COVID-19 patients. This resonates with findings from the present study, which found that systolic blood pressure predicts unfavourable health outcomes among HCWs. Thus, HCWs with elevated systolic blood pressure are likely to contract COVID-19 when they become exposed to any patient presenting with symptoms of COVID-19.

5.3.4 Effect of COVID-19 on Lung Function among HCWs

The present study established that most HCWs experienced abnormal lung function at baseline, midline, and end line. This is consistent with findings from some studies, which revealed that individuals who recovered from SARS showed persisting abnormalities in their breathing during prospective follow-up that lasted for months or even years (Schelling et al., 2000; Orme et al., 2003). In addition, the findings from the present study agree with a one-year longitudinal study of survivors of SARS in China, which reported that the first six months following recovery were characterized by persistent abnormalities seen with lung function tests and impairment in diffusing capacity for carbon monoxide (Hui et al., 2005). Similarly, Clavario et al. (2020) used CPET in 110 patients and observed that 34% of non-severe patients had decreased aerobic capacity three months after discharge, mostly related to muscle impairment.

Similar findings were shown one month following discharge: 70% of patients had decreased peripheral muscle mass (Blokland et al. 2020), and patients had lower aerobic capacity, which was probably due to physical deconditioning rather than changes in pulmonary function (Gao et al., 2021). This agrees with findings from the present study, which found reduced aerobic capacity levels in the exposed HCWs group. Furthermore, in 58 patients, Raman et al. (2021) found that the aerobic capacity of COVID-19 patients was lower 2-3 months after the beginning of symptoms than that of controls (54% vs 7.4%). The finding rehashes the results of the present study, which established that HCWs in the exposed group had reduced lung function.

Furthermore, the impact of COVID-19 on lung function in the early stages of recovery was examined in a retrospective study of COVID-19 patients at the Fifth Affiliated Hospital of Sun Yat-sen University (Huang et al., 2020). According to the study, 75.4% of the patients had abnormal pulmonary function testing results, and 52.6% of patients had FVC, FEV1, FEV1/FVC ratio, TLC, and lung diffusing capacity for carbon monoxide values that were less than 80% of anticipated values. Though this study was retrospectively done, the findings are consistent with the present study, which found that HCWs exposed to COVID-19 had reduced aerobic capacity. Thus, COVID-19 attacks the organs, particularly the lungs, making breathing difficult for patients, irrespective of profession.

Frija-Masson and colleagues (2020) made similar observations of stress ranging from mild to severe in 45 patients. They noted that the Pulmonary Function Test [PFT] anomaly rate was greater in patients with severe disease. Thus, 81% of the patients in this group exhibited abnormal PFTs, with the majority showing a decreased total leukocyte count [TLC] and decreased DLCO. This is consistent with the findings from the present study, which found that HCWs exposed to COVID-19 had reduced aerobic capacity. In a similar vein, Van et al. (2020)

conducted one of the largest European trials, gathering PFT measures from 124 patients with COVID-19 infection approximately three months following hospital release. Comparing the disease severity of this cohort, no differences were observed in spirometry or static lung volumes. While over one-third of patients with moderate disease (33%) and over half of patients with critical (55%) or severe (54%) disease had significantly impaired DLCO, all patients with mild disease had DLCO within normal levels. This resonates with findings from the present study, which found that workplace characteristics of HCWS in the exposed had no significant association with reduced aerobic capacity.

5.3.5 Effect of Lifestyle and Physical Activity and COVID-19 Health Outcomes

Regular exercise lowers the chance of acquiring chronic illnesses, including type 2 diabetes, cardiovascular disease, and respiratory conditions (Ross et al., 2016). This is consistent with the findings from the present study, which established a significant association between exercise and depression, anxiety, and stress. The findings from the present study further corroborate the fact that poor diet appears to be a key contributor to the rise in the incidence of chronic illnesses and obesity (Kant 2010). Being obese has psychological burnout as it is a predisposing factor for depression, anxiety, and stress. Studies show that specific dietary habits may influence inflammatory markers associated with low-grade systemic inflammation (Casas et al. 2014; Del Chierico et al. 2014). Findings from this study also resonate with findings from the present study, which found that lifestyle choices have a significant association with health outcomes such as depression, anxiety, and stress. Thus, HCWs who smoke are more likely to be depressed than those who do not smoke.

The significant association observed between exercise and health outcomes (depression, anxiety, and stress) from the present study suggests that physical inactivity is linked to impaired immunological response both directly and indirectly through the vicious loop between inactivity and obesity (Pietiläinen et al. 2008; Laddu et al. 2020). This indicates that hypertrophic adipose tissue, associated with excess body fat, experiences hypoxemia and endoplasmic reticulum stress, leading to the activation of inflammatory genes and a persistent inflammatory response. Therefore, inactivity has a deleterious effect on host defence and immunological function.

A cross-sectional study on perceived lifestyle changes after the outbreak of COVID-19 and their association with subjective well-being (SWB) among the general population in Mainland China found that inactive physical exercise, infrequent vegetable intake, infrequent fruit intake were associated with lower SWB after adjusting for sociodemographic factors, self-rated physical health, perceived social support, and loneliness (Hu et al., 2020). This is consistent with the findings from the present study, which established a significant association between exercise and reduced levels of depression, anxiety, and stress among HCWs exposed to COVID-19. To assess risk factors for SARS-CoV-2 infection in patients, such as poor diet, obesity, and physical inactivity, another study employed cross-sectional investigations. A more severe form of the disease affected patients with lower levels of physical activity or lower MET.min/week ($p = 0.05$ and $p = 0.03$, respectively), according to an evaluation of their impacts on the severity and duration of the condition (Tavakol et al. 2021). These results support the current study's findings, which suggest that increased physical activity may lessen the severity of COVID-19 illness in some cases. The similarity in the findings suggests that the busy schedule of healthcare workers during the peak of COVID-19 could affect the rate at which they exercise. However, there are huge differences in the number of COVID-19 cases during the peak of the virus. The differences at the peak of the pandemic, notwithstanding, make physical activeness the priority of the individual, irrespective of profession. Thus, some

HCWs could be active but contract the virus and vice versa, probably due to their inability to sleep well. Again, the way of life of some HCWs could be altered due to the pandemic, and most could struggle to overcome such challenges.

5.3.6 Effect of Family/Work-Related Support on COVID-19 Health Outcomes

People who were infected but asymptomatic were forced to live in isolation, either by themselves or with other family members who shared their condition. They were terrified of developing severe symptoms and frequently felt abandoned by the healthcare systems. Nursing home residents who had been denied even the closest family member visits and contact for months had developed a sense of panic and neglect, which had worsened their pre-existing depression or dementia status (Reinhold et al., 2021). This resonates with findings from the present study, which established a significant association between HCWs with a family history of comorbidities and depression. The similarity in the finding could be attributed to the fact that hospitalized patients were segregated into their rooms, interacting only with the medical staff, who were clad in masks and other personal protective equipment. Therefore, the limited opportunities to learn the health status of other family members throughout the inpatient stay and no family communication could account for the depression (Reinhold et al., 2021).

Findings from the study showed that HCWs in the exposed group who received moderate support from their immediate supervisors had 51% reduced odds of experiencing depression. This corroborates the fact that those [HCWs] who lived at home without any form of support were at a significant risk of developing anxiety and depression symptoms (Brooks et al., 2020). Many people may have fallen into the anxiogenic loop of constant news reporting about contagions and pandemic-related casualties, which exacerbated anxiety and depression due to a lack of antihuman contact and separation from reality. According to earlier research (Petit et al., 2018; Howard et al., 2018), people with hypertension are more prone to experience psychological discomfort or anxiety, and they also have more difficulties expressing their emotions in stressful settings (Pappaccogli et al., 2019). This agrees with the findings of the study, which revealed that HCWs in the exposed group who have a family history of hypertension are likely to experience severe anxiety and stress. These unfavourable emotions, exacerbated by lockdown, self-isolation, familial and personal issues, as well as psychological pain relating to one's own or a relative's health, may have led to a worsening of health outcomes.

Furthermore, findings from the study showed that lack of support from the workplace significantly affects the psychological well-being of HCWs. This suggests that HCWs need the support of management to weather the storm of discrimination. This resonates with a study in China, which revealed that healthcare professionals were more likely to experience stigmatization and rejection in their neighbourhoods due to their employment at the hospital (Bai et al. 2004). A significant amount of psychological discomfort and sadness might result from this stigmatization (Kinsman, 2012; Zhang et al., 2020a). They may have intense symptoms, like in incidents where neighbours threw stones at medical personnel and drove them from their homes during the Ebola pandemic (Guimard et al., 1999). Providing early and correct information about the condition may lessen the stigmatization of healthcare professionals.

5.3.7 Effect of COVID-19 on Presenteeism among HCWs Post-Recovery

Findings from the study revealed that there were higher odds of experiencing high levels of presenteeism among HCWs with severe levels of anxiety compared with those with moderate/mild levels of anxiety. This supports the fact that the number of days it takes a person to get back to work has an impact on productivity loss, as does the length of the quarantine, the duration of the treatment, and the absence from work (Yaghoubi, Salimi, & Meskarpour-Amiri, 2022). It usually takes 10 to 14 days for a person to be able to go back to work (Wang, Lee, & Zhou, 2020).

Once more, the results of this investigation showed a statistically significant relationship between presenteeism and HCWs exposed to COVID-19 at endline. According to research conducted in Saudi Arabia among physicians, nurses, dentists, pharmacists, and other professionals at a tertiary facility, 74% of the staff said they had presenteeism at some point in the previous year (Al-Nuhait et al. 2017). In addition, the findings from the study confirm other studies on stress among Chinese HCWs, which revealed a significant link between stress and presenteeism, such that as stress increased, presenteeism also increased (Yang et al. 2019; Yang et al. 2018). Burnout among HCWs is made more likely by these issues (Allemann, Siebenhüner, & Hämmig, 2019). Again, a study among Croatian nurses revealed a significant association between stress and presenteeism but not an association with absenteeism (Brborovic, Brborovic, & Mustajbegovic, 2016). This agrees with findings from the present study, which found that HCWs with severe levels of stress were likely to experience high levels of presenteeism compared to others with normal stress levels.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

The chapter presents the conclusion and recommendations based on the study's results. Section one presents the conclusion of the study. Section two presents the study's contribution to knowledge. Section three presents the recommendations, which are also presented based on the objectives and results of the study.

6.2 Conclusion

The study's conclusions are based on the results and specific objectives presented.

In assessing the clinical characteristics and management of COVID-19 among HCWs, this study enrolled healthcare workers (HCWs) who had previously tested positive for COVID-19 using RT-PCR. Among those with comorbidities, a predominant proportion had a history of diabetes. During the active phase of the disease, prevalent signs and symptoms included common cold, cough, loss of taste, fever, headache, and fatigue. The participants primarily consisted of youthful individuals who tested positive for COVID-19 upon their initial test and did not require hospital admission. Commonly utilized supplements and medications among HCWs encompassed vitamins C/Zinc and Azithromycin/Doxycycline, respectively.

Additionally, more than half of the participants relied on herbal remedies, predominantly neem tree concoctions or steam inhalation, in treating COVID-19 aside from the use of orthodox medicines. Notably, individuals with comorbidities experienced milder forms of the disease, while those with a history of smoking or alcohol consumption experienced more severe manifestations of COVID-19. The health status of HCWs is paramount to the sustainability of healthcare systems.

Psychological symptoms such as depression, anxiety, and stress were assessed using the DASS-21. The findings showed that these symptoms were high throughout the data collection period, though it reduced over the period among the HCWs. These complaints were significantly higher among HCWs in the exposed group.

Healthcare workers who were infected with COVID-19 reported self-symptoms of psychological health challenges. There were significant variations between sociodemographic factors (such as age, marital status, number of dependents, tertiary education, and other works), and depression, anxiety, and stress were common in healthcare workers exposed to COVID-19. Also, there was substantial variation between blood pressure, lung function, exposure to COVID-19, and personal characteristics of healthcare workers. Those with a bachelor's degree or higher experienced normal blood pressure compared to those with a diploma education. Likewise, lung function was normal among those who had never married.

Several risk factors were identified to influence the psychological, blood pressure, and lung function of healthcare workers exposed to COVID-19. Exposure to second-hand smoke varied significantly between depression and anxiety. While walking/cycling and vigorous-intensity sports significantly reduce depression, anxiety, and stress, alcohol consumption plays a significant role in reducing anxiety among some healthcare workers.

The study identified several interactive effects of work-related support, family/personal history of a disease, and health outcomes. Providing support to healthcare workers exposed to COVID-19 moderately reduced the chance of high blood pressure. While healthcare workers in the exposed group who have a family history of diabetes are likely to experience severe levels of stress, others experienced reduced lung function levels.

The work output of healthcare workers post-COVID-19 recovery was measured with the Presenteeism scale. The abridged Presenteeism scale compared with the original scale, provided an elaborate overview of healthcare work productivity. The present study showed that health workers who contracted COVID-19 were more likely to experience presenteeism than those who did not. Also, productivity was reduced among healthcare workers with severe levels of depression and anxiety. This proves the significance of stakeholders prioritizing the health and safety of HCWs in the face of disease outbreaks since it can affect the quality of work.

6.3 Recommendations

The following recommendations are made in the context of the specific objectives informed by the results.

6.3.1 Recommendation to the Ministry of Health (MOH)

- The Traditional Medicine department of the Ministry of Health should liaise with the Centre for Plant Medicine Research to fund research in assessing the effectiveness of herbal medicines e.g. Neem tree in the management of COVID-19, and if effective, incorporate its use in hospitals in Ghana,
- To reduce presenteeism among HCWs in future pandemics like COVID-19, the MOH should enact policies to insure the lives of HCWs in the event they contract or die from an infectious disease while in line of duty. This will provide some form of cushion when they are ill and their family, professional associations, or health facilities cannot fund their healthcare. It is also important that incentives, such as monetary allowance or any other reward system, are in place for frontline HCWs. This will give them confidence in doing their best to care for patients during disease outbreaks like COVID-19.
- The Ministry of Health should develop clinical practice guidelines for the management of COVID-19 among HCWs. This is key to reducing post COVID-19 complications.

6.3.2 Recommendation to the Ghana Health Service (GHS)

- To safeguard HCWs, the in-service department in hospitals must provide comprehensive training in Infection Prevention Control practices and ensure stringent adherence to these measures within healthcare facilities.
- HCWs should consistently have access to PPE to mitigate their exposure risk to COVID-19.
- The Public Health Division of the GHS must keep educating HCWs on the essence of receiving the full dose of the COVID-19 vaccination to reduce their risk of contracting the disease and developing severe COVID-19 even if they do contract it.
- The clinical research division of the GHS should conduct or fund further studies exploring the clinical attributes and management of COVID-19 among HCWs, encompassing laboratory and imaging findings to enhance understanding of the disease dynamics among HCWs.
- The Public Relations division of the GHS must also liaise with the media, and the National Commission on Civic Education to regulate the type of information that is put in the public domain during times like the COVID-19 pandemic to reduce depression, anxiety, and stress among HCWs.
- The GHS must liaise with the Ghana Psychology Association and the Mental Health Authority and empower the hospital psychology departments to ensure they counsell HCWs during disease outbreaks such as COVID-19. This is key to improving their mental health and reducing medical errors and presenteeism at work.

6.3.3 Recommendation to Healthcare workers

- HCWs must engage in healthy lifestyles, such as eating right and exercising. They should prioritize their health through regular medical check-ups and adhere to treatment regimens when prescribed medications by their physician.

- HCWs must be each other's keepers and encourage each other in the face of pandemics. They should be able to recommend their colleagues to see a psychologist when they are stressed, burned out, or psychologically traumatized due to their experience with diseases like COVID-19 and work overload.

6.3.4 Future Research

Future studies that target coping strategies of healthcare workers infected with COVID-19 are needed. While the current study used a quantitative method, mixed methods could be used in this regard. The mixed methods design could help the researcher to understand the experiences and coping strategies from the perspective of the healthcare workers in the qualitative part of the study to augment the findings from the quantitative design.

Again, future research should conduct diagnostic tests such as Magnetic Resonance Imaging to understand the pathology of the lungs during and after COVID-19 infection. Laboratory investigations such as Blood Urea and Creatinine, Liver function test, Lipid profile among others will be key to understanding the effect of COVID-19 on organs.

Lastly future studies should assess Mean Arterial Blood Pressure (MAP) to understand blood perfusion to the body organs during and after COVID-19 infection.

These are key to detecting potential complications and addressing them as if HCWs are not well attended to medically, their development of health complications will affect the health system of Ghana.

6.3.5 Contributions to Knowledge

The findings from the present study contribute to the limited studies on the impact of COVID-19 on the health and work output of healthcare workers in selected hospitals in Ghana. This research showed that;

- HCWs supplement orthodox medicine with herbal preparations in the management of COVID-19.
- Being infected with COVID-19 predisposes HCWs to presenteeism
- Having been previously married, having a personal history of comorbidity, aging, and lifestyle choices such as smoking and alcoholism influence the psychological state of HCWs who were exposed to COVID-19 more significantly than those who were not exposed
- Mental health issues such as depression, anxiety, and stress among HCWs who were diagnosed with COVID-19 improve over time, just as lung function.
- HCWs may not develop hypertension within 6 months of recovering from COVID-19.

6.3.6 Contribution to Policy and Practice

This study is novel as it is one of the few studies conducted on the health outcomes of healthcare workers exposed to COVID-19 at four referral hospitals in two regions of Ghana. The findings from the present study can contribute to the current or future policy and practice processes on infectious disease management in Ghana and elsewhere. The Ministry of Health and the Ghana Health Service has developed National guidelines for Laboratory testing and reporting on respiratory infectious diseases in health facilities in Ghana and Ghana's COVID-19 emergency preparedness and response project and additional financing (Ministry of Health, 2020 a, b). Therefore, findings from the present study could inform revisions to areas in the policy documents that are silent on the well-being of the healthcare worker. Considering that depression, anxiety, and stress, as well as lack of institutional support, could influence the productivity of healthcare workers during infectious disease outbreaks, the Ghana Health Service, Ministry of Health, Ghana Psychological Council, and other stakeholders such as in the healthcare industry must ensure that healthcare workers are well trained to understand effective coping strategies that could enhance their wellbeing during disease outbreak. This will improve service quality in healthcare, especially in public healthcare facilities where patient turnout is continuously rising.

6.3.7 Contribution to Methodology

The Ambi-directional cohort study design made it easy to collect data from the study participants when they were in the active phase of the disease as well as follow them up to 6 months post-COVID-19 recovery. This improved the quality of data for data needed for analysis to fulfil the study's objectives. The Census was used to help recruit as many participants as possible who met the inclusion criteria and were willing to participate in the study. Therefore, the results of this study could be generalized to the target population. The researcher minimized biases in this study by strictly adhering to the validity and reliability criteria.

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College of Health Sciences

University of Ghana

Appendix 1: Participant's Consent Form

Tittle of study: IMPACT OF COVID 19 ON THE HEALTH AND WORK OUTPUT OF HEALTHCARE WORKERS IN SELECTED HOSPITALS WITHIN THE GREATER ACCRA REGION OF GHANA

Introduction

Researcher: Benson Owusu

Department: Biological, Environmental and Occupational Health Sciences

Phone: +233(0)247586344

Email address: bowusu056@st.ug.edu.gh

Background of the study

Health-care providers are vital resources for every country. Their health and safety are crucial not only for continuous and safe patient care, but also for control of any outbreak. However, health-care providers caring for patients during the severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS) outbreaks were under extraordinary stress related to high risk of infection, stigmatization and uncertainty, and comprehensive support was a high priority during the outbreaks and afterwards (Lee et al. 2018; Maunder et al. 2003). Studies have shown that frontline healthcare providers treating patients with COVID-19 have greater risks of mental health problems, such as anxiety, depression, insomnia, and stress (Liu et al. 2020; Vindegaard & Benros, 2020). Beyond the psychological impact, frontline healthcare providers are at a greater risk of developing cardiopulmonary diseases such as hypertension and reduced lung function. All these can end up affecting the work output of these healthcare workers leading to presenteeism. when they become infected with COVID 19. I am undertaking a study on assess the post recovery health impacts of COVID 19 on health workers in the Greater Accra Region with particular focus on Tema General Hospital, Shai Osudoku district hospital, Achimota hospital and the Greater Accra Regional Hospital. Consent will be sought from HCWs prior to their participation in the study.

Nature of study

The study hopes to assess the post recovery health impact of COVID-19 on healthcare workers in Tema General Hospital, Shai Osudoku district hospital, Achimota hospital and the Greater Accra Regional Hospital. It is an ambi-directional prospective cohort study which will employ the use of sphygmomanometer, spirometer, stadiometer as well uses a structured questionnaire to solicit information from the respondents.

Duration

It will be an ambi-directional cohort study where the participants who had recovered from COVID-19 will be asked about the experience with COVID-19 and all the participants including those who never had COVId-19 will be followed up for a period of 6months

Potential risks/benefits

The study will not cause any discomfort to participants. It is hoped that results obtained for this study will be used by policy makers and the management of the hospital to continuously monitor patients and HCWs who have recovered from COVID-19 to ensure they have fully recovered without any form of complications.

Privacy/Confidentiality

I would like to assure you that whatever information provided will be handled with strict confidentiality and will be used purely for the research purposes. Your data will not be shared with anybody who is not part of the research team. Data analysis will be done at the aggregate level to ensure anonymity. Your identity will not be disclosed in the material that will be published.

Voluntary withdrawal and compensation

Participation in this study is voluntary and participants can choose not to answer any particular question or all questions. You are at liberty to withdraw from the study at any time without prejudice from the study team. However, it is encouraged that you participate since your opinion is important in determining the outcome of the study. You will not be provided any reward/compensation to respond to the questionnaire.

Provision of information and consent form

A copy of the information sheet will be given to you after it has been signed or thumb-printed to take home.

Ethical Approval

The study will be reviewed and approved by the Ghana Health Service Ethics Review Committee (GHS-ERC). This committee is there to ensure that participants in researches are protected from harm and their rights are respected.

Before taking Consent

Do you have any questions you wish to ask about the study? Yes |____| No |____|

If yes, please, indicate the questions below

……………………………………………………………………………………

……………………………………………………………………………………………

In case you have any questions on the study later please, do not hesitate to contact **Benson Owusu**, Department of Biological, Environmental and Occupational Health Sciences at the School of Public Health, University of Ghana. (Tel: 0242370840) Email: bowusu056@st.ug.edu.gh

Also, if you need further clarifications on ethical issues please, kindly contact the GH-ERC Administrator, Miss Hannah Frimpong on: 0243235225/0507041223.

Consent Form

I……………………………………., declare that the purpose of the study has been thoroughly explained to me in English language/Ga/Twi and I have understood. I hereby agree to answer the questions. I understand that it is voluntary and can opt out at any time.

Signature…………………………. Date………………………………

Thumb print

Witness Statement

I declare that I was present while the benefits and procedures were read to the participants and all questions were answered and the participant agreed to take part in the study.

Witness signature………………………… Date ……………………..

Interviewer's Statement

I, the undersigned, have explained this consent form to the subject in English/Ga/Twi so that he/she understands the purpose of the study, the procedures to be followed, and the risks and benefits involved. The subject has freely agreed to participate in the study.

Interviewer's signature…………………………

Date……………………………. Address……………………………

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Appendix 2: Research Questionnaire

IMPACT OF COVID 19 ON THE HEALTH AND WORK OUTPUT OF HEALTHCARE WORKERS IN SELECTED HOSPITALS WITHIN THE GREATER ACCRA REGION OF GHANA

Dear Respondent,

This is research being carried out on the above topic. I would, therefore, like to take some minutes of your precious time to answer these questions. You are assured that the answers you give will be strictly confidential and your name will not be mentioned in our research reports. Thank You

QUESTIONNAIRE

TOPIC: IMPACT OF COVID-19 ON THE HEALTH AND WORK OUTPUT OF HEALTHCARE WORKERS IN SELECTED HOSPITALS WITHIN THE GREATER ACCRA REGION OF GHANA

Hospital ID *(hospID)*: ____________________ Participant's ID *(studyID)*: ______________ Interviewer's ID (Int_ID) Participant's Tel: _______________________	Date of COVID-19 diagnosis: _____________ *(diagnosed)* (dd-mm-yyyy) Date of Recruitment: _____________________ *(recruit)* (dd-mm-yyyy) Date of Interview:________________________ *(interview)* (dd-mm-yyyy) Start Time of interview: -----------------------

I am about to ask you questions to determine if you are eligible to participate in this study

INFORMED CONSENT	
a. Does the participant meet all inclusion criteria?	a. Yes b. No
b. Do you consent to be part of the study?	a. Yes b. No

I want to ask you questions on your background characteristics

Instruction: Please Tick (√) appropriate response

A: BACKGROUND CHARACTERISTICS

No.	**Question**	**Response**	
1.	Participant's Age	____________________	*Page*
2	Participant's sex	[1] Female [0] Male	*sex*
3	Current place of work	a. Greater Accra Regional Hospital b. Shai Osudoku District Hospital c. Achimota Hospital d. Tema General Hospital	*placeOfWork*
4	How many other places do you work (apart from your current place of work)?	0 1 2 3 4 or more	*placeOfWork1*
5	What is your highest Level of Education	[1] No formal education [2] Primary school but uncompleted [3] Primary school completed [4] Middle school uncompleted [5] Middle school completed [6]Senior High School uncompleted [7]Senior high school completed [8]Diploma completed [9]Diploma uncompleted [10] University completed [11] University uncompleted	*educ*
6	Religion	Catholic=0 Protestant=1 Pentecostal/Charismatic=2 Muslim=3	*religion*

		Traditional/spiritualist=4 Agnostic=5 Atheist=6 I prefer not to talk about it=7 Other, (Please specify)…………………………………	
7	Which of the following best describes your profession	[1] Doctor [2] Nurse [3] Laboratory Scientist [4] Pharmacist [5] Morgue attendant [4] Other, (Please specify)…………………………	*employ*
8	What is your rank	…………………………..	*rank*
9	How many years have you worked in your current place of work?	……………………..	*Years_work*
10	Which of the following best describes your Marital status?	[1] never married [2] Married [3] Divorced [4]Separated [5]Widowed/Widower [6] Co-habiting [7] I don't want to talk about it	*maritalstatus*
11	What is your monthly net salary?	[1] less than GH₵ 1,000 [2] GH₵ 1,001 – 2,000 [3] GH₵ 2,001 – 3,000 [4] More than GH₵ 3,000	*Net_salary*
12	Number of dependents	------------- children ------------- adolescents ------------- adults None	*dependents*

COMORBIDITY
I want to ask questions about your personal and family history of comorbidity

No.	Question	Response				Variable
13	Do you have any family history of a disease?	a) Yes **b)** No **(skip to number 15)**				*familyHxDx*
14	**Who among the family has it and which disease (Tick all that applies)**	DISEASE	FATHER	MOTHER	SIBLING	*familyHxDx1*
		Hypertension	a.Yes b.No c.Unknown	a.Yes b.No c.Unknown	a.Yes b.No c.Unknown	
		Diabetes	a.Yes b.No c.Unknown	a.Yes b.No c.Unknown	a.Yes b.No c.Unknown	
		Asthma	a.Yes b.No c.Unknown	a.Yes b.No c.Unknown	a.Yes b.No c.Unknown	
		Mental illness	a.Yes b.No c.Unknown	a.Yes b.No c.Unknown	a.Yes b.No c.Unknown	
		Sickle Cell Disease	a.Yes b.No c.Unknown	a.Yes b.No c.Unknown	a.Yes b.No c.Unknown	
		Chronic obstructive pulmonary disease	a.Yes b.No c.Unknown	a.Yes b.No c.Unknown	a.Yes b.No c.Unknown	
		Renal disease	a.Yes b.No c.Unknown	a.Yes b.No c.Unknown	a.Yes b.No c.Unknown	
		Liver disease	a.Yes b.No c.Unknown	a.Yes b.No c.Unknown	a.Yes b.No c.Unknown	

		Other (specify) …………… ……………..	

15	Did you have any known disease chronic disease before the COVID 19 pandemic?	a.Yes b.No **(skip to number 19)**	*PersonaHxDx*
16	If Yes to **Question 25**, What disease (check all that apply)	[1] Hypertension [2] Diabetes mellitus [3] Asthma [4] Renal disease [5] Liver disease [6] HIV [7] Mental illness [8] COPD [9] Sickle Cell Disease [10] Other (Specify)	
17`	Are you currently on any medication?	a.Yes b.No **(skip to number 19)**	

18	If Yes, what are these medications? (explain for each disease)	....	*Drug_Hx*

LIFESTYLE

Now I am going to ask you some questions about various lifestyles that can influence your health. These include; smoking, drinking alcohol and physical activity. Let's start with smoking

19. Have you ever smoked cigarettes for a year or more??

a. Never smoked **(skip to number 24)**

b. Former smoker **(skip to number 20)**

c. Current smoker **(skip to number 22)**

20. How old were you when you started smoking

……………………..

21. How many sticks of cigarettes did you smoke each day, on average

…………………………….

22. How old were you when you started smoking?

23. How many sticks of cigarettes do you smoke each day on average?

24. Do you have friends or family members who smoke?

a. Yes

b. No **(skip to number 26)**

25. Approximately how many sticks of cigarettes does the person smoke per day?

………………………..

26. Do you think you are exposed to second hand smoke?

a. Yes

b. No **(skip to number 30)**

27. Where is the place of exposure to the second hand smoke? (Tick all that applies)

a. Home

b. Public places

c. Other (Specify)………………..

28. Approximately how many days per week are you exposed to second-hand smoke?

a. Daily

b.1-2 days

c. 3-4days

d. 5-6days

28. Approximately how many hours per day are you exposed to second hand smoke?

a. 1-4hours

b. More than 4hours

ALCOHOL CONSUMPTION

30. Have you ever consumed an alcoholic drink such as beer, wine, and spirits?

a. Yes
b. No (**skip to question 34)**

31. Have you consumed an alcoholic drink within the past 12 months?

a. Daily
b. 1-4days per weeks

c. 1-3 days per month
d. Less than once a month

32. Have you consumed an alcoholic drink within the past 30 days

a. Yes
b. b. No (**skip to question 34)**

33. During the past 30 days, on how many times did take an alcoholic drink?

……………………..

PHYSICAL ACTIVITY

Next I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person. Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, study/training, household chores, harvesting food/crops, fishing or hunting for food, seeking employment. [Insert other examples if needed]. In answering the following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate.

34. Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate?

a. Yes
b. No **(skip to question 37)**

35. In a typical week, on how many days do you do vigorous-intensity activities as part of your work?

…………………………….

36. How much time do you spend doing vigorous-intensity activities at work on a typical day?

…………………..

37. Does your work involve moderate-intensity activity, that causes small increases in breathing or heart rate such as brisk walking [or carrying light loads] for at least 10 minutes continuously?

a. Yes
b. No **(skip to question 40)**

38. In a typical week, on how many days do you do moderate-intensity activities as part of your work?

………………………

39. How much time do you spend doing moderate-intensity activities at work on a typical day?

………………………

The next questions exclude the physical activities at work that you have already mentioned. Now I would like to ask you about the usual way you travel to and from places. For example to work, for shopping, to market, to place of worship

40. Do you walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to get to and from places?

a. Yes
b. No **(skip to question 43)**

41. In a typical week, on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places?

………………………

42. How much time do you spend walking or bicycling for travel on a typical day?

…………………………

The next questions exclude the work and transport activities that you have already mentioned. Now I would like to ask you about sports, fitness and recreational activities (leisure)

43. Do you do any vigorous-intensity sports, fitness or recreational (leisure) activities that cause large increases in breathing or heart rate like [running or football] for at least 10 minutes continuously?

a. Yes
b. No **(skip to question 46)**

44. In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational (leisure) activities?

……………………………….

45. How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?

…………………………….

46. Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that cause a small increase in breathing or heart rate such as brisk walking, [cycling, swimming, volleyball] for at least 10 minutes continuously?

a. Yes
b. No **(skip to question 49)**

47. In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (leisure) activities?

……………………..

48. How much time do you spend doing moderate-intensity sports, fitness or recreational (leisure) activities on a typical day?

……………………

COVID-19 INFECTION CLINICAL CHARACTERISTICS

I am about to ask you some questions in relation to your experience with COVID-19 infection
COVID-19 Screening characteristics

49. Have you ever done COVID-19 test (Polymerase Chain Reaction)?
    a. Yes
    b. No

50. How many times have you had the COVID-19 test done?
    a. Once
    b. Twice
    c. Thrice
    d. More than 3 times

51. What informed your decision to get tested for COVID-19 infection?
    a) I was exhibiting COVID-19 signs and symptoms (go to 52)
    b) I just decided to get tested (go to 53)
    c) I was exposed to a COVID 19 patient (go to 53)
    d) It was my facilities policy to get tested (go to 53)

52. Which of the following did you exhibit? (Choose all that applies)

a) Fever

b) Difficulty in breathing

c) Cough

d) Cold

e) Loss of taste

f) Loss of smell

g) Headache

h) Fatigue

i) Diarrhea

j) Other (Please specify) …….

53. Have you ever tested positive for COVID-19?
a. Yes
b. No **(skip to number 55)**

54. How many times have you tested positive for COVID-19
a. Once
b. Twice
c. Thrice
d. More than 3 times

55. How long did it take for you to receive your COVID-19 results?
 a) Within 72hours
 b) 1 week- 2weeks
 c) 2-4weeks
 d) More than a month

56. Have you been vaccinated against COVID-19 infection?
 a) Yes, full dose
 b) Yes, partial dose
 c) No **(Skip to number 58)**

57. Have you tested positive after vaccination?
a. Yes
b. No

58. Which of the following best describes your experience with COVID-19 infection
a. I was not admitted to hospital with resumption of normal activities
b. I was not admitted to hospital, but unable to resume normal activities
c. I was admitted to hospital but not requiring supplemental oxygen
d. I was admitted to hospital but requiring supplemental oxygen

MANAGEMENT OF COVID-19 INFECTION

I am about to ask you some questions in relation to how you were managed for COVID-19 infection

e. I was admitted to hospital requiring high-flow nasal cannula (HFNC), non-invasive mechanical ventilation (NIV), or both
f. I was admitted to hospital requiring extracorporeal membrane oxygenation, invasive mechanical ventilation (IMV), or both
g. I have never had COVID-19 infection **(Skip to number 66)**

59. Where did you receive treatment for the COVID-19 infection?
    a) I was managed at home **(Skip to number 61)**
    b) I was admitted at the COVID-19 isolation/treatment center
    c) I was admitted at the COVID-19 Intensive care unit

60. If you were admitted, how long did you stay on admission?
    a) 1 week or less
    b) Two weeks
    c) Three weeks
    d) 1 month or more

61. Which of the following clinical investigations did you do (Tick all that applies)?
    a. Chest x-ray
    b. Electrocardiogram (ECG)
    c. Procalcitonin
    d. Troponin
    e. C-Reactive Protein (CRP)
    f. Chest Computed Tomography (CT) Scan
    g. Magnetic Resonance Imaging (MRI)
    h. Full blood count
    i. Blood Urea and Creatinine (BUE & Cr)
    j. Liver function test
    k. D-Dimer
    l. Lactate Dehydrogenase (LDH)
    m. Ferritin
    n. Other (Please Specify

62. Which medications were you managed with? Tick all that applies.
    a. Hydroxychloroquine
    b. Ivermectin
    c. Azithromycin
    d. Doxycycline
    e. Rocephin (Ceftriaxone)
    f. Meronem
    g. Methylprednisolone

h. Dexamethasone
i. Tocilizumab
j. Vitamin C+Zinc
k. Remdesevir
l. Soluble aspirin
m. Xarelto
n. Clexane/Fragmin
o. Decathylene Losenges
p. Rhinathiol
q. Other (please Specify)

63. Were the medications supplied to you by the hospital or you bought them yourself?
a. I bought them myself
b. They were provided by the hospital
c. Either ways

64. Did you take any herbal concoction in managing the disease?
a) Yes
b) No Never **(Skip to number 65)**

65. If yes to **Ques 61,** which herbal preparations were you taking? **(list all in the space provided)**

……………………………………

FAMILY/OCCUPATIONAL FACTORS INFLUENCING HEALTH DURING THE COVID-19 PANDEMIC

I am about to ask questions related to family/occupational factors that can influence your health as a health worker during the COVID-19 pandemic

66. Have you been seeking the services of a psychologist?
a) Yes
b) No **(skip to question 68)**

67. Who recommended you to the psychologist
a. I personally engaged him
b. He was recommended to me by my hospital
c. He was assigned to me by a family member
d. Other, specify

68. Do you have family members you can rely on for advise when you need it
a. Yes

b. No
c. I don't want to talk about it

69. Do you have Family members to take care of you when you are sick?
a. Yes
b. No
c. I don't want to talk about it

70. Can you get practical help with your work from colleagues if you need it?
a. To a very large extent
b. To a large extent
c. Somewhat
d. To a small extent
e. To a very small extent

71. Can you get advice and guidance from your colleagues if you need it?
a. To a very large extent
b. To a large extent
c. Somewhat
d. To a small extent
e. To a very small extent

72. Are you able to tell your colleagues about difficulties you experience at work?
a. To a very large extent
b. To a large extent
c. Somewhat
d. To a small extent
e. To a very small extent

73. Are your colleagues attentive to your wellbeing?
a. To a very large extent
b. To a large extent
c. Somewhat
d. To a small extent
e. To a very small extent

74. Can you express your feelings to your closest colleagues?
a. To a very large extent
b. To a large extent
c. Somewhat
d. To a small extent
e. To a very small extent

75. Can you get practical help with your work from your immediate supervisor if you need it?
a. To a very large extent
b. To a large extent
c. Somewhat

d. To a small extent
e. To a very small extent

76. Can you talk with your immediate supervisor about difficulties you experience at work?
a. To a very large extent
b. To a large extent
c. Somewhat
d. To a small extent
e. To a very small extent

77. Does your immediate supervisor follow up on conversations about any difficulties you have experienced at work?
a. To a very large extent
b. To a large extent
c. Somewhat
d. To a small extent
e. To a very small extent

78. Can you get advice and guidance from your immediate supervisor if you need it?
a. To a very large extent
b. To a large extent
c. Somewhat
d. To a small extent
e. To a very small extent

79. Have you received any insurance benefit since you recovered?
a) Yes
b) No **(skip to number 81)**

80. If Yes to the above, was it from your personal or institutional insurance
a. It was my personal insurance
b. It was my institutions insurance

81. Have you within the last 12 months experienced discrimination or been treated poorly due to COVID-19?
a. To a very large extent
b. To a large extent
c. Somewhat
d. To a small extent
e. To a very small extent

82. Who discriminated or treated you poorly?

a. Overall management

b. Immediate supervisor

c. Colleagues

d. Subordinates

e. Patients

83. Does your work put you in emotionally disturbing situations?

a. Always
b. Often
c. Sometimes
d. Seldom
e. Never/hardly

84. Do you have to relate to other people's personal problems as part of your work?

a. Always
b. Often
c. Sometimes
d. Seldom
e. Never/hardly

PSYCHOLOGICAL ASSESSMENT

I am about to ask questions to assess your psychological experience within the past 2 weeks	
Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement. The rating scale is as follows: 0 Did not apply to me at all 1 Applied to me to some degree, or some of the time 2 Applied to me to a considerable degree or a good part of time 3 Applied to me very much or most of the time	
1 (s) I found it hard to wind down	**0 1 2 3**
2 (a) I was aware of dryness of my mouth	**0 1 2 3**
3 (d) I couldn't seem to experience any positive feeling at all	**0 1 2 3**
4 (a) I experienced breathing difficulty (e.g. excessively rapid breathing, breathlessness in the absence of physical exertion)	**0 1 2 3**
5 (d) I found it difficult to work up the initiative to do things	**0 1 2 3**
6 (s) I tended to over-react to situations	**0 1 2 3**
7 (a) I experienced trembling (e.g. in the hands)	**0 1 2 3**
8 (s) I felt that I was using a lot of nervous energy	**0 1 2 3**
9 (a) I was worried about situations in which I might panic and make a fool of myself	**0 1 2 3**
10 (d) I felt that I had nothing to look forward to	**0 1 2 3**
11 (s) I found myself getting agitated	**0 1 2 3**
12 (s) I found it difficult to relax	**0 1 2 3**
13 (d) I felt down-hearted and blue	**0 1 2 3**

14 (s) I was intolerant of anything that kept me from getting on with what I was doing	**0 1 2 3**
15 (a) I felt I was close to panic	**0 1 2 3**
16 (d) I was unable to become enthusiastic about anything	**0 1 2 3**
17 (d) I felt I wasn't worth much as a person	**0 1 2 3**
18 (s) I felt that I was rather touchy	**0 1 2 3**
19 (a) I was aware of the action of my heart in the absence of physical exertion (e.g. sense of heart rate increase, heart missing a beat)	**0 1 2 3**
20 (a) I felt scared without any good reason	**0 1 2 3**
21 (d) I felt that life was meaningless	

WORK OUTPUT ASSESSMENT

I am about asking you questions on the effect of COVID-19 on your work output

Direction: Below we would like you to describe your work experiences in the past month. These experiences may be affected by many environmental as well as personal factors and may change from time to time. For each of the following statements, please circle one of the following responses to show your agreement or disagreement with this statement in
describing *your* work experiences in the past month.
Please use the following scale:
Circle:
1 if you strongly disagree with the statement
2 if you somewhat disagree with the statement
3 if you are uncertain about your agreement with the statement
4 if you somewhat agree with the statement
5 if you strongly agree with the statement

Statement	**Your work experience in the past month:**
1. Because of my health problem, the stresses of my job were much harder to handle.	**1 2 3 4 5**

2. Despite I have a health problem, I was able to finish hard tasks in my work.	**1 2 3 4 5**
3. My health problem distracted me from taking pleasure in my work.	**1 2 3 4 5**
4. I felt hopeless about finishing certain work tasks, due to my experience a health problem	**1 2 3 4 5**
5. At work, I was able to focus on achieving my goals despite having a health problem	**1 2 3 4 5**
6. Despite having my having a health problem, I felt energetic enough to complete all my work.	**1 2 3 4 5**

Lung function **I am about to conduct a spirometry test to determine your lung function. After the first test, I will nebulize you before the second and third test. This will help determine the accurate lung function**			
		Weight…… (Kg) Height ……………(meters)	
	Spirometric measurements	vital capacity (VC)________________________	*vc*
		Forced vital capacity (FVC)_____________ _______________	*fvc*
		Forced expiratory volume (FEV)_______________	*fev*
		Forced expiratory volume in 1 second (FEV_1)	*fev1*

BLOOD PRESSURE MEASUREMENT

I am about to check your blood pressure. I will check it 3 times and take the average as your actual blood pressure reading			
	Device ID Cuff size used Reading 1	……………… Small Medium Large Systolic (mmHg) ……………. Diastolic (mmHg) ……………	

	Reading 2 Reading 3 During the past two weeks, have you been treated for raised blood pressure with drugs (medication) Prescribed by a doctor or other health worker?	Systolic (mmHg) ……………. Diastolic (mmHg) …………… Systolic(mmHg) ……………. Diastolic (mmHg) …………… a. Yes b.No	

End Time …………………

Appendix 3: Multicollinearity Variance Factor

Variables	VIF	Tolerance (1/VIF)
Exposed to COVID-19 (those who had the COVID-19 infection)	2.75	0.363047
Depression		
Moderate/mild	3.04	0.328422
Severe	4.26	0.234521
Anxiety		
Moderate/mild	1.78	0.562711
Severe	7.41	0.13499
Stress		
Moderate/mild	2.61	0.38272
Severe	2.88	0.346796
High blood pressure	1.38	0.726388
Reduced lung function (FEV1/FVC)	1.27	0.785911
Age group		
30-39	3.71	0.269393
40-49	2.25	0.444001
50-60	2.08	0.48111
Sex : Males	1.78	0.561338
Bachelors degree or higher	2.82	0.354471
Religion		
Muslim	1.31	0.764556
Others	1.21	0.824142
Marital status		
Married	4.18	0.239258
Previously married	1.43	0.699108
Number of dependents		
1-2 dependents	2.11	0.472835
3-4 dependents	2.38	0.420841
5+ dependents	1.84	0.544484
Having other part time job	2.21	0.452786
Profession		
Nurse	6.43	0.155582
Laboratory scientist	1.39	0.719981
Pharmacist	1.49	0.671826
Midwives	2.5	0.400336
Years worked		
5-9 years	2.16	0.462512
10-14 years	2	0.5003
15+ years	2.08	0.481143
Family history of a comorbidity	6.14	0.162759
Family history of hypertension	5.04	0.198428
Family history of diabetes	1.64	0.610015
Personal history of a comorbidity	2.65	0.376765
Have asthma	1.78	0.563291

Have diabetes	1.86	0.536821
Currently smoking/Ever smoked	1.27	0.784344
Family/friends smokes	1.47	0.678586
Exposed to second hand smoking	1.53	0.654939
Ever consumed alcohol	1.92	0.521622
Work involves vigorous-intensity activities	1.83	0.545497
Work involves moderate-intensity activities	3	0.332893
Walk/cycles daily for least 10 minutes	2.53	0.395135
Does vigorous-intensity sports	1.99	0.503688
Does moderate-intensity sports	2	0.500889
Have been seeking the services of a psychologist	1.36	0.734379
Family members to take care of you when you are sick	1.34	0.743753
Support from work colleague		
Moderate support	4.04	0.247807
High support	11.2 5	0.088878
Supervisors support		
Moderate support	4.6	0.217341
High support	10.3 5	0.096616
Work related emotional toll		
Moderate	4.2	0.237942
High	3.82	0.261475
Number of COVID-19 test		
Twice	2.07	0.483641
Thrice	1.54	0.650415
Four or more	2.57	0.389251
Reason for testing		
I Just decided to test	1.78	0.560969
Was exposed to a COVID-19 patient	4.68	0.213492
Facility policy to get tested	5.36	0.186562
How long it took to receive COVID-19 results after testing		
1-2 weeks	1.92	0.521252
2-4 weeks	1.53	0.651657
More than a month	1.31	0.765353
Ever had vaccination against COVID-19		
Yes, partial dose	1.49	0.673142
No	1.4	0.716081
Symptoms: Fever	3.56	0.280813
Symptoms: Difficulty in breathing	1.76	0.569149
Symptoms: Fatigue	2.78	0.35998
Symptoms: Diarrhea	1.31	0.761385
Average VIF	**2.87**	

Appendix 5: Ethical clearance

In case of reply the number and date of this Letter should be quoted.

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
Digital Address: GA-050-3303
Mob: +233-50-3539896
Tel: +233-302-681109
Fax + 233-302-685424
Email: ethics.research@ghsmail.org
14th May, 2021

My Ref. GHS/RDD/ERC/Admin/App 21/147
Your Ref. No.

Benson Owusu
University of Ghana
School of Public Health
P. O. Box LG 13
Legon-Accra

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol.

GHS-ERC Number	**GHS-ERC 003/03/21**
Study Title	Health Impact of COVID-19 among Healthcare Workers Post-Recovery: A Study in Selected Hospitals within the Greater Accra Region
Approval Date	14th May, 2021
Expiry Date	13th May, 2022
GHS-ERC Decision	**Approved**

This approval requires the following from the Principal Investigator

- Submission of a yearly progress report of the study to the Ethics Review Committee (ERC)
- Renewal of ethical approval if the study lasts for more than 12 months,
- Reporting of all serious adverse events related to this study to the ERC within three days verbally and seven days in writing.
- Submission of a final report after completion of the study
- Informing ERC if study cannot be implemented or is discontinued and reasons why
- Informing the ERC and your sponsor (where applicable) before any publication of the research findings.

You are kindly advised to adhere to the national guidelines or protocols on the prevention of COVID -19

Please note that any modification of the study without ERC approval of the amendment is invalid.

The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Kindly quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED...

Dr. Cynthia Bannerman
(GHS ERC Chairperson)

Cc: The Director, Research & Development Division, Ghana Health Service, Accra

RESEARCH AND DEVELOPMENT UNIT OF THE GREATER ACCRA REGIONAL HEALTH DIRECTORATE

REQUIREMENTS FOR RESEARCH APPROVAL FOR INDIVIDUALS AND INSTITUTIONS

The Research and Development Unit of the Greater Accra Regional Health Directorate is focused on ensuring relevant researches are conducted to address key health issues within the region.

To attain this broad objective the Research Division of the region will work closely with all individuals and organizations to ensure relevant research studies are conducted within the region.

KEY REQUIREMENTS FOR RESEARCH APPROVAL

1. The research to be conducted should be relevant to the region or the specific study site where the research will be implemented.
2. Proof of ethical clearance obtained for the study where applicable.
3. Provision of research proposals (soft or hardcopy) by the principal investigator (PI).
4. A copy of the research findings upon completion of the study (soft or hardcopy).

The research proposal should include but not limited to the following;

a. Key areas for Research
b. Study Title
c. Study Type
d. General Objectives and specific objectives
e. Period over which the research will be undertaken
f. District(s)/ Specific study sites where the research will be undertaken
g. Email & Contact of PI.
h. Collaborators (Institution)

The research and development unit of the region shall ensure the above requirements have been met before permission is granted for the research to be implemented within the region.

31/5/2021 Mr. Owusu Benson has met requirements to start research in GAR.
Thank You.
Dr. Hilagro

UNIVERSITY OF GHANA
DEPARTMENT OF BIOLOGICAL, ENVIRONMENTAL AND OCCUPATIONAL HEALTH
SCHOOL OF PUBLIC HEALTH

February 18, 2021

The Medical Director
Tema General Hospital
Tema

Dear Sir/Madam,

LETTER OF INTRODUCTION- BENSON OWUSU (10598525)

I am pleased to introduce to you the above-named PhD candidate in the Department of Biological, Environmental and Occupational Health Sciences in the School of Public Health, University of Ghana, Legon.

As part of the requirement for the award of a Doctoral Degree , He is conducting a research titled **"Health Impact of COVID-19 among Healthcare Workers Post-recovery: A study in Selected Hospitals within the Greater Accra Region."**

The general objective of this study is to assess the health impact of COVID-19 on health workers who have recovered from the disease in selected hospitals within the Greater Accra Region.

It is my hope that you will give him the necessary assistance to enable him carry out the research work.

I count on your support and assistance.

Yours sincerely,

Dr. Mawuli Dzodzomenyo
(Head of Department)

UNIVERSITY OF GHANA
DEPARTMENT OF BIOLOGICAL, ENVIRONMENTAL AND OCCUPATIONAL HEALTH
SCHOOL OF PUBLIC HEALTH

May 20, 2021

The Regional Director
Greater Accra Regional Directorate
Accra

Dear Sir/Madam,

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Yours sincerely,

Dr. Mawuli Dzodzomenyo
(Head of Department)

COLLEGE OF HEALTH SCIENCES
P.O. Box LG 13, Legon, Accra, Ghana.
Telephone: +233 (0)28 910 9002 · Email: sph-beohs@ug.edu.gh · Website: www.publichealth.ug.edu.gh

UNIVERSITY OF GHANA
DEPARTMENT OF BIOLOGICAL, ENVIRONMENTAL AND OCCUPATIONAL HEALTH
SCHOOL OF PUBLIC HEALTH

February 18, 2021

The Medical Director
Shai Osudoku District Hospital
Dodowa

Dear Sir/Madam,

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UNIVERSITY OF GHANA
DEPARTMENT OF BIOLOGICAL, ENVIRONMENTAL
AND OCCUPATIONAL HEALTH
SCHOOL OF PUBLIC HEALTH

February 18, 2021

The Medical Director
Achimota Hospital
Accra

Dear Sir/Madam,

LETTER OF INTRODUCTION- BENSON OWUSU (10598525)

I am pleased to introduce to you the above-named PhD candidate in the Department of Biological, Environmental and Occupational Health Sciences in the School of Public Health, University of Ghana, Legon.

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